Bay Area Air Quality Management District

COUNCIL MEETING

April 25, 2016

Bay Area Air Quality Management District

Agenda

- Approval of Minutes
- Public Comment on Agenda Matters
- Presentation on Crude Slate
- Presentations on Efficacy of GHG caps
- Presentation on Low Carbon Fuel Standard
- Council Deliberation

Approval of Minutes

Welcome

Jack P. Broadbent

Executive Officer / APCO

Public Comment on Agenda Items

Gordon Schremp

California Energy Commission
Energy Assessments Division

Presentation and Discussion:

Crude Slate at Northern California Refineries

California Refinery Overview and SF Bay Area Crude Oil Slate

BAAQMD Council Meeting

San Francisco, CA

April 25, 2016

Gordon Schremp

Energy Assessments Division

California Energy Commission

Gordon.schremp@energy.ca.gov

Presentation Topics

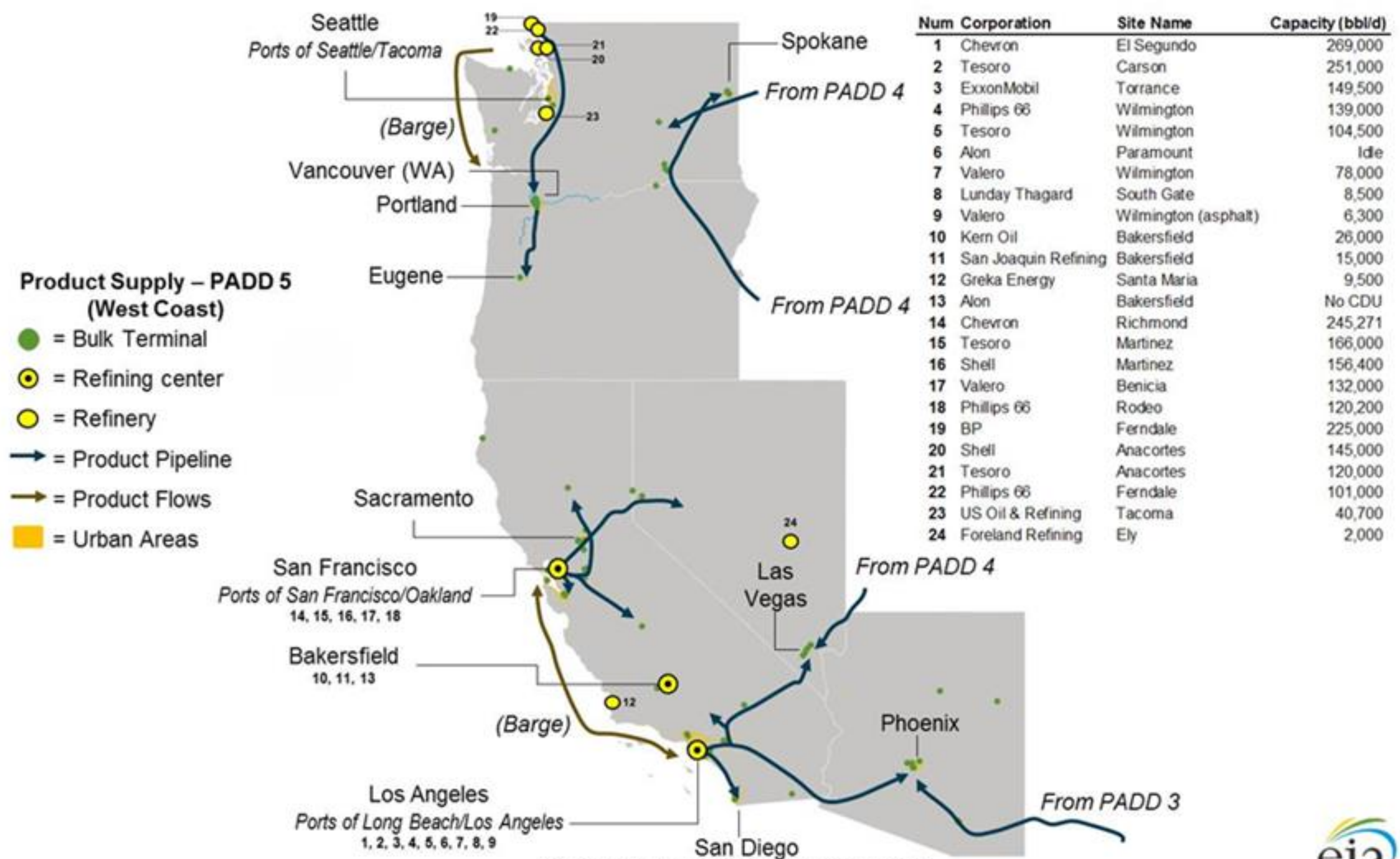
- Transportation fuel infrastructure overview
  - West Coast, California & San Francisco Bay Area
- Crude oil sources
- Refinery operations overview
- Crude oil slate
  - Properties
  - Yields
  - Density & sulfur trends
  - Diversity
  - Carbon intensity

Transportation Fuel Infrastructure Overview

- The California transportation fuel "infrastructure" consists of several interconnected assets operated by a combination of refiner and third-party companies
  - Refineries
  - Pipelines
  - Marine terminals
  - Storage tanks
  - Rail
- Crude oil and petroleum product infrastructure assets are separate and distinct from one another – not interchangeable
- Unlike with the electricity distribution system, Northern California is not directly connected to Southern California

Western States More Isolated than Rest of U.S.

West Coast petroleum product supply map



Num	Corporation	Site Name	Capacity (bbl/d)
1	Chevron	El Segundo	269,000
2	Tesoro	Carson	251,000
3	ExxonMobil	Torrance	149,500
4	Phillips 66	Wilmington	139,000
5	Tesoro	Wilmington	104,500
6	Alon	Paramount	Idle
7	Valero	Wilmington	78,000
8	Lunday Thagard	South Gate	8,500
9	Valero	Wilmington (asphalt)	6,300
10	Kern Oil	Bakersfield	26,000
11	San Joaquin Refining	Bakersfield	15,000
12	Greka Energy	Santa Maria	9,500
13	Alon	Bakersfield	No CDU
14	Chevron	Richmond	245,271
15	Tesoro	Martinez	166,000
16	Shell	Martinez	156,400
17	Valero	Benicia	132,000
18	Phillips 66	Rodeo	120,200
19	BP	Ferndale	225,000
20	Shell	Anacortes	145,000
21	Tesoro	Anacortes	120,000
22	Phillips 66	Ferndale	101,000
23	US Oil & Refining	Tacoma	40,700
24	Foreland Refining	Ely	2,000

Source: U.S. Energy Information Administration.

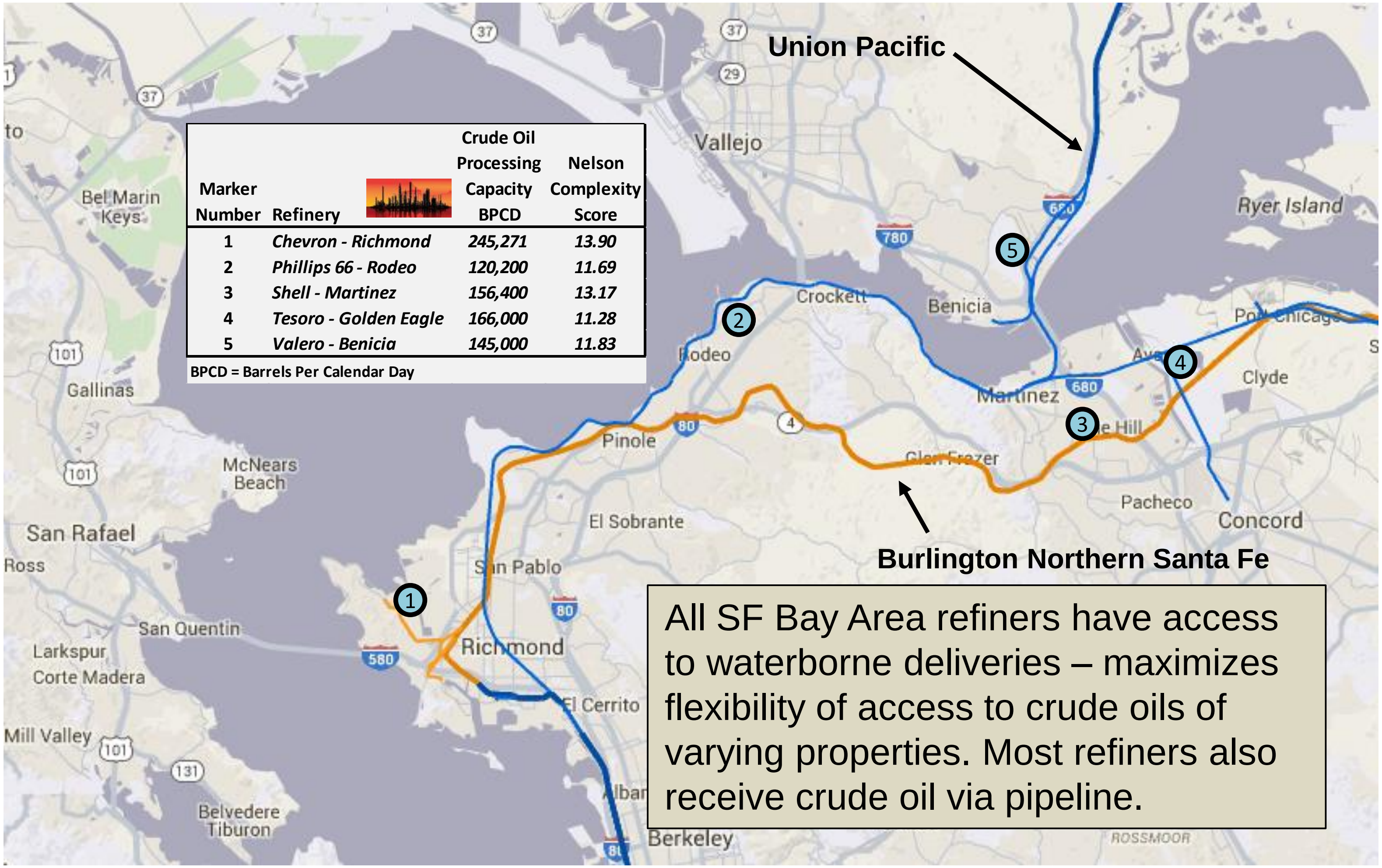
California Refineries

- 3 primary refinery locations
- 12 refineries produce transportation fuels that meet California standards
- 8 smaller refineries produce asphalt and other petroleum products
- California refineries provide majority of transportation fuel to neighboring states
- Process over 1.6 million barrels per day of crude oil

California Refineries

- Refineries are a primary hub of logistical activity
  - Raw materials imported & finished products shipped
- Crude oil receipts during 2014 received by
  - Marine vessels (foreign) - 787.1 TBD
  - Marine vessels (Alaska) – 190.5 TBD
  - California source via pipelines – 664.8 TBD
  - Rail/truck – 15.7 TBD
- Process units operate continuously at or near maximum capacity, except during periods of planned maintenance or unplanned outages

SF Bay Area Refineries



Marker Number	Refinery	Crude Oil Processing Capacity BPCD	Nelson Complexity Score
1	*Chevron - Richmond*	*245,271*	*13.90*
2	*Phillips 66 - Rodeo*	*120,200*	*11.69*
3	*Shell - Martinez*	*156,400*	*13.17*
4	*Tesoro - Golden Eagle*	*166,000*	*11.28*
5	*Valero - Benicia*	*145,000*	*11.83*

BPCD = Barrels Per Calendar Day

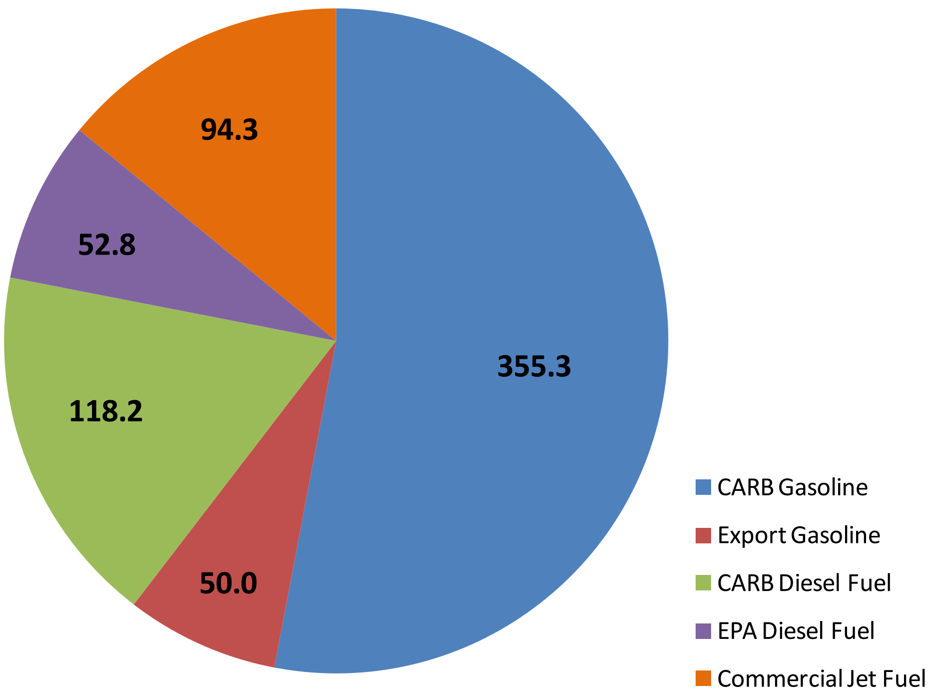
All SF Bay Area refiners have access to waterborne deliveries – maximizes flexibility of access to crude oils of varying properties. Most refiners also receive crude oil via pipeline.

Sources: Oil Change International map, Energy Information Administration refinery data and California Energy Commission analysis.

SF Bay Area Refinery Activity

- The minority of transportation fuels used in California are produced in Northern California
- California share
  - CARB Gasoline 39.9 %
  - CARB Diesel 48.7 %
  - Jet Fuel 34.4 %
  - Export Fuel 45.2 %
- Crude oil processing
  - 754.8 TBD
- Crude marine imports
  - Foreign – 415.4 TBD
  - Alaska – 70.9 TBD
  - North Dakota – 3.4 TBD
- Crude rail imports
  - Domestic – 3.5 TBD
- Pipeline receipts
  - San Joaquin Valley – 261.6 TBD

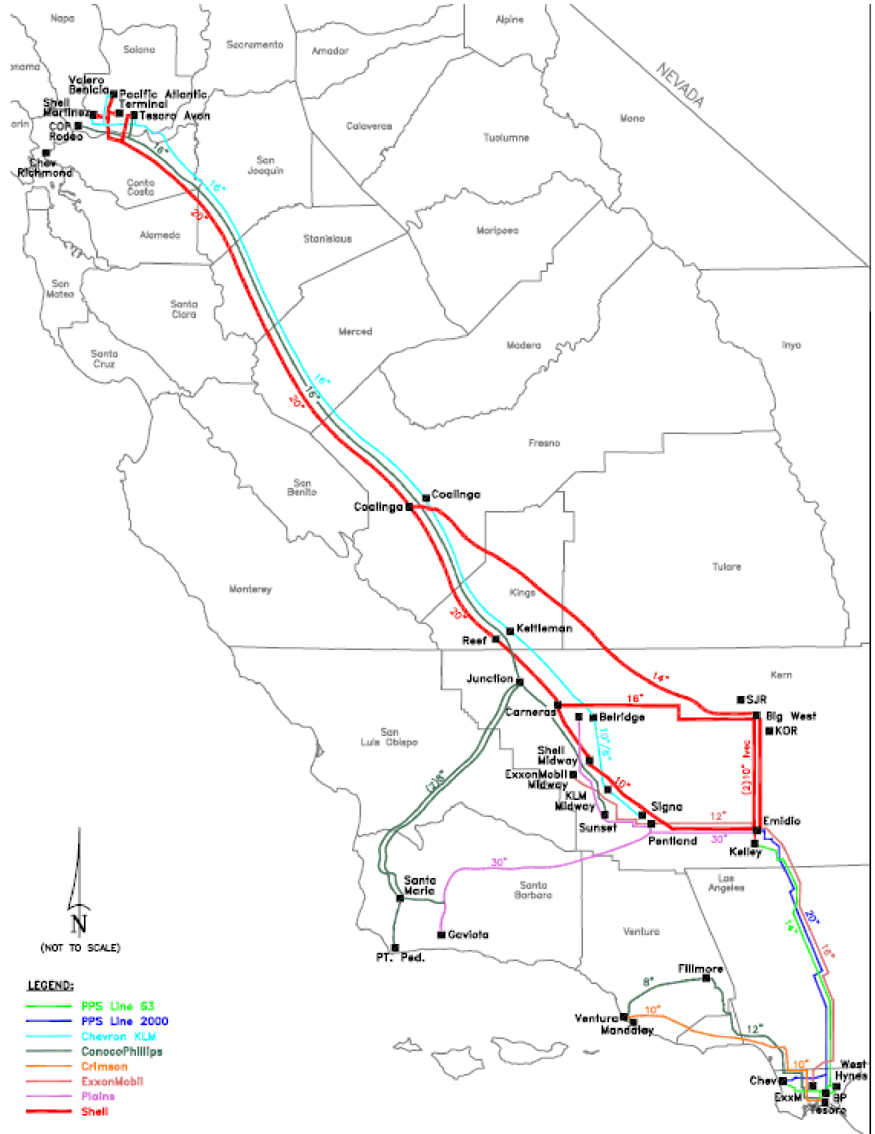
Northern California Refinery Production
Thousands of Barrels Per Day



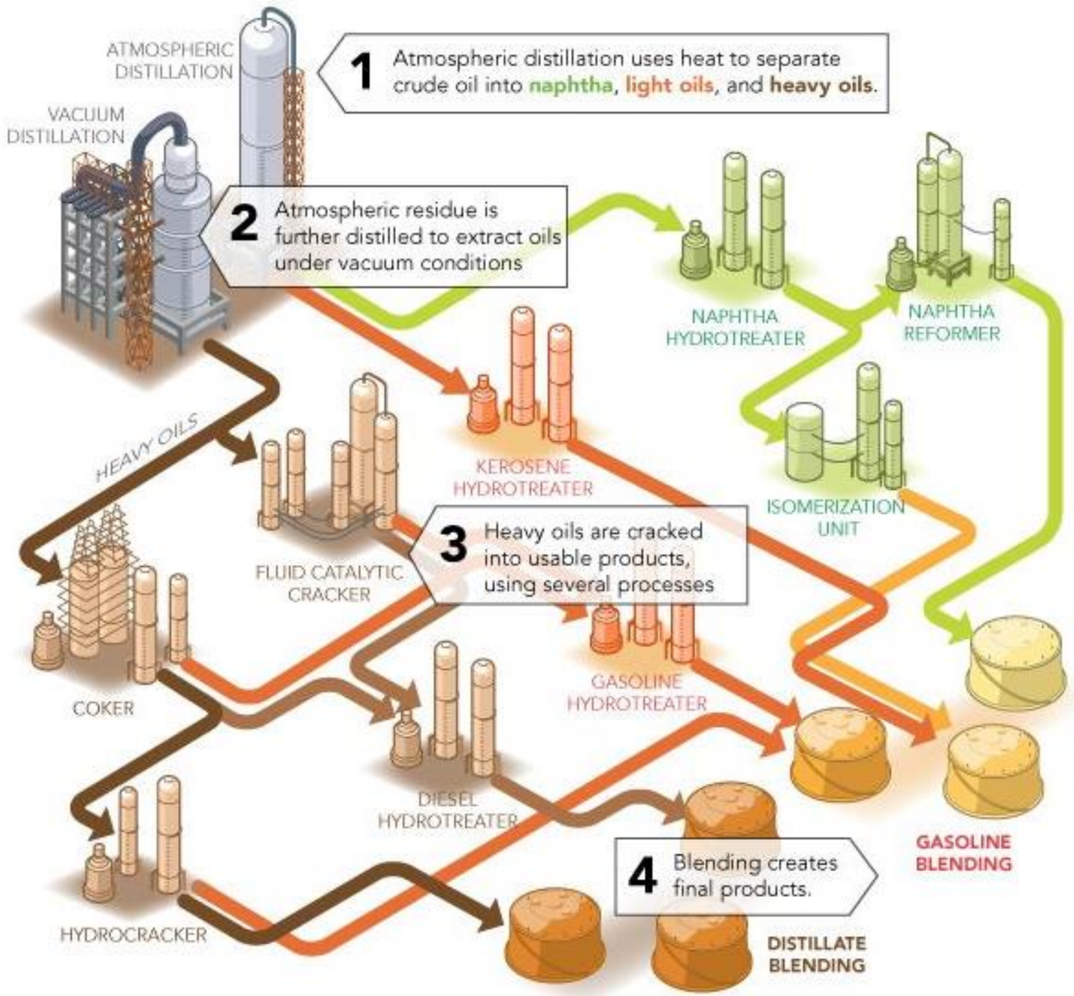
Source: California Energy Commission - Weekly Refinery Reports

Crude Oil Sources – SF Bay Area Refineries

- SF Bay Area refineries processed 754.8 thousand barrels per day of crude oil during 2014
  - 261.6 TBD pipeline shipments
  - 35 percent of crude oil received
- SF Bay Area refineries processed 45.5 percent of total crude oil
- Crude-by-rail likely to back out marine receipts of similar quality
- Rail capability increases flexibility to enhance supply options & reduces risk of crude oil receipt curtailment



Refineries & Process Units

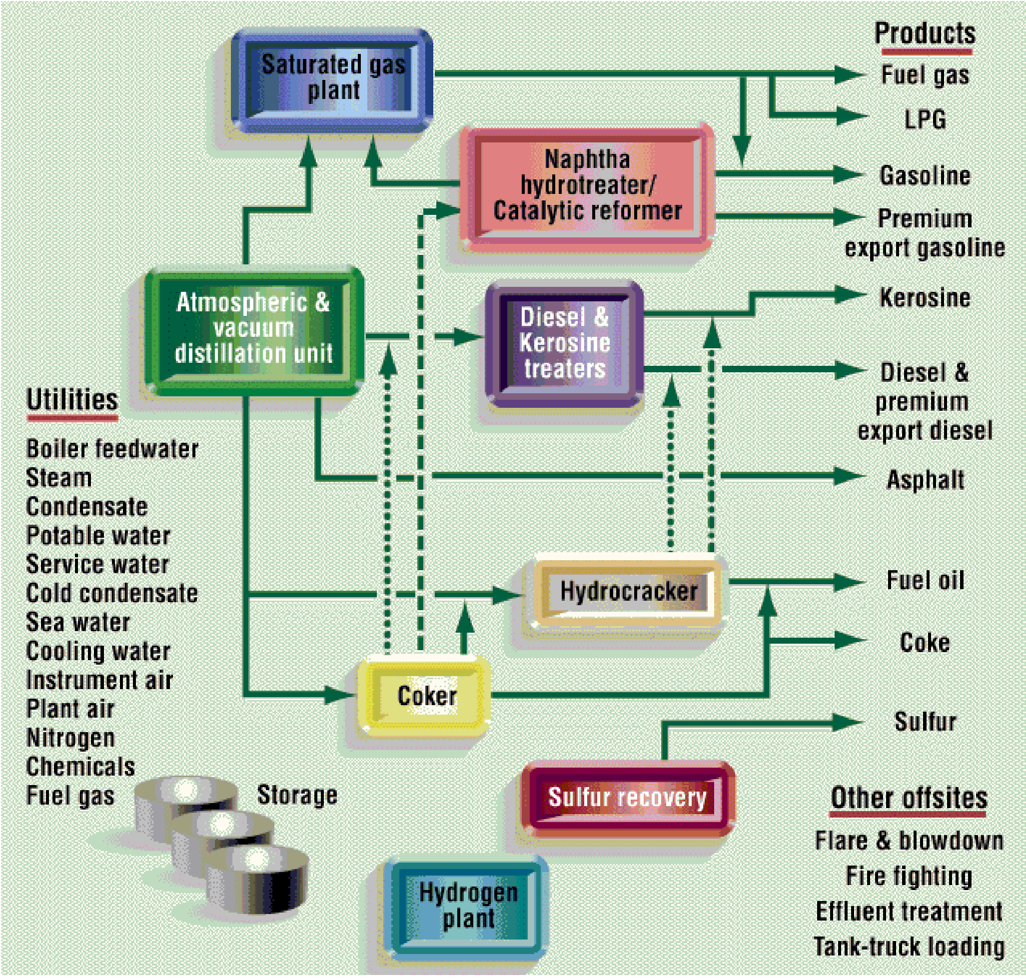


Source: supplychainn.blogspot.com

- First step in refining – distillation - uses heat and pressure to break down crude oil mixtures
- Produces mostly intermediate components that require further processing by other refinery equipment
- California refineries are of high complexity and capable of processing wide variety of crude oils to meet some of the most stringent fuel standards

Refineries – Must Maintain Balance

- Refiners must optimize operations to ensure system remains in balance:
  - Steam load
  - Sulfur plant operations
  - Refinery gases
  - Cogeneration operations & electrical loads
  - Hydrogen use
- All refinery inputs end up being consumed or converted
- Storage capacity is finite



Source: Oil & Gas Journal

Crude Oil Variability Poses Challenges

Refinery equipment capabilities

Crude oil properties

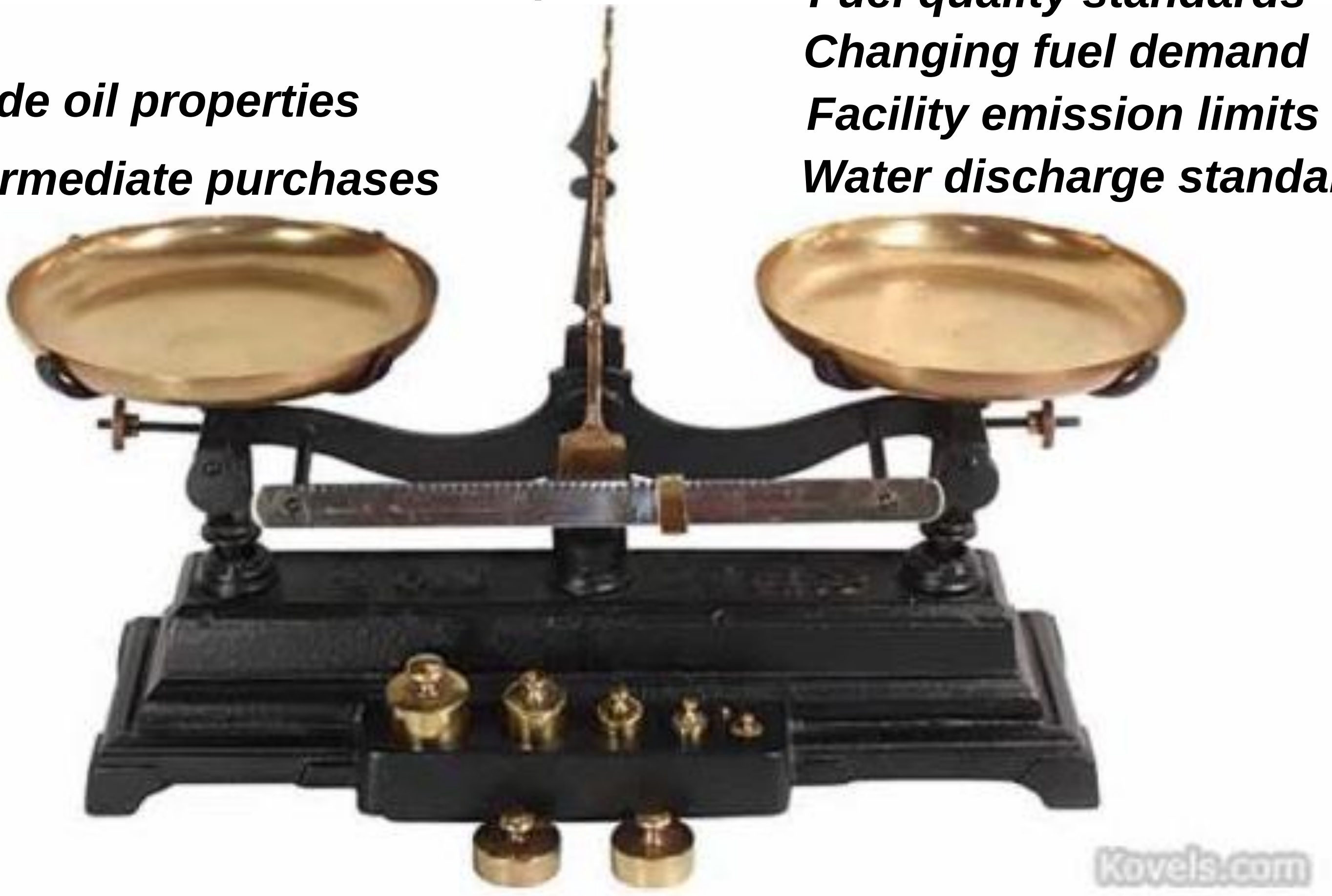
Intermediate purchases

Fuel quality standards

Changing fuel demand

Facility emission limits

Water discharge standards



Crude Oil Slate

Crude Oil Properties

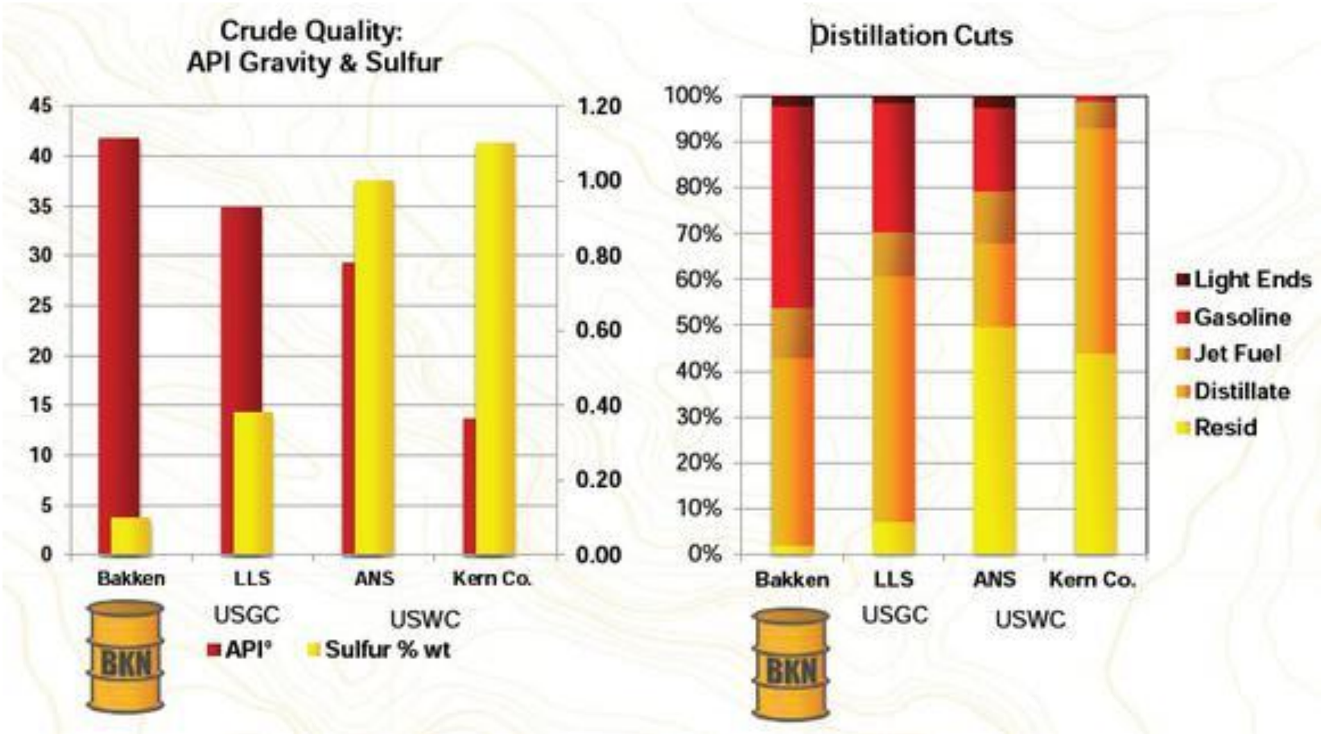
Several key properties

- Sulfur
  - Hydrogen needs & sulfur plant limits
- Density
  - Distillation profile
  - Storage & handling
- Metals
  - Sodium, magnesium, vanadium & nickel
  - Corrosion & catalyst deactivation
- Total Acid Number (TAN)
  - High temperature corrosion & fouling
- Nitrogen
  - Catalyst deactivation

Other important considerations

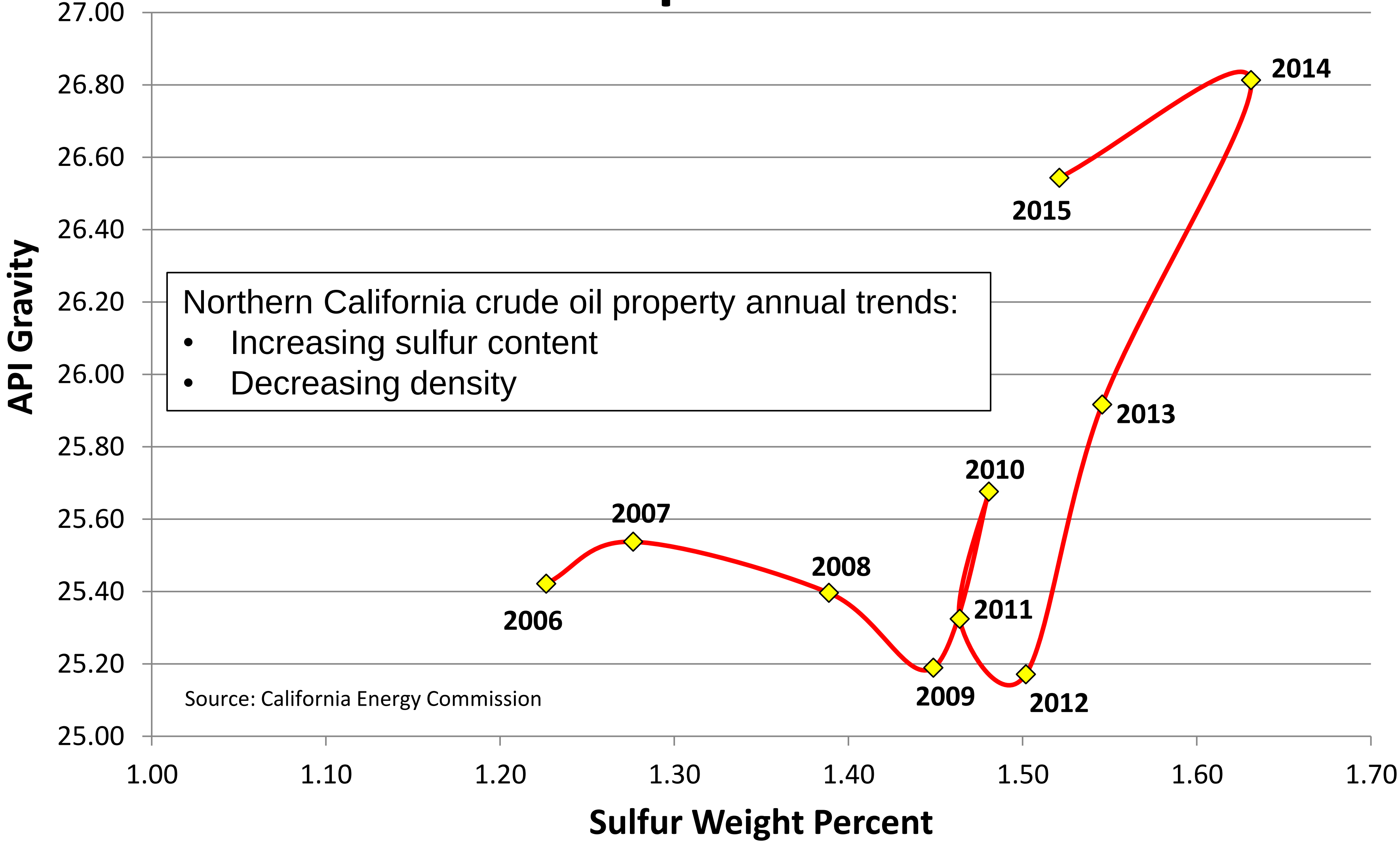
- Salt content
  - Corrosion
- Organic chlorides
  - Corrosion
- Reid vapor pressure (Rvp)
  - Storage tank limits
- Wax content
  - Fouling

Distillation Profile - Crude Oil Yields Vary

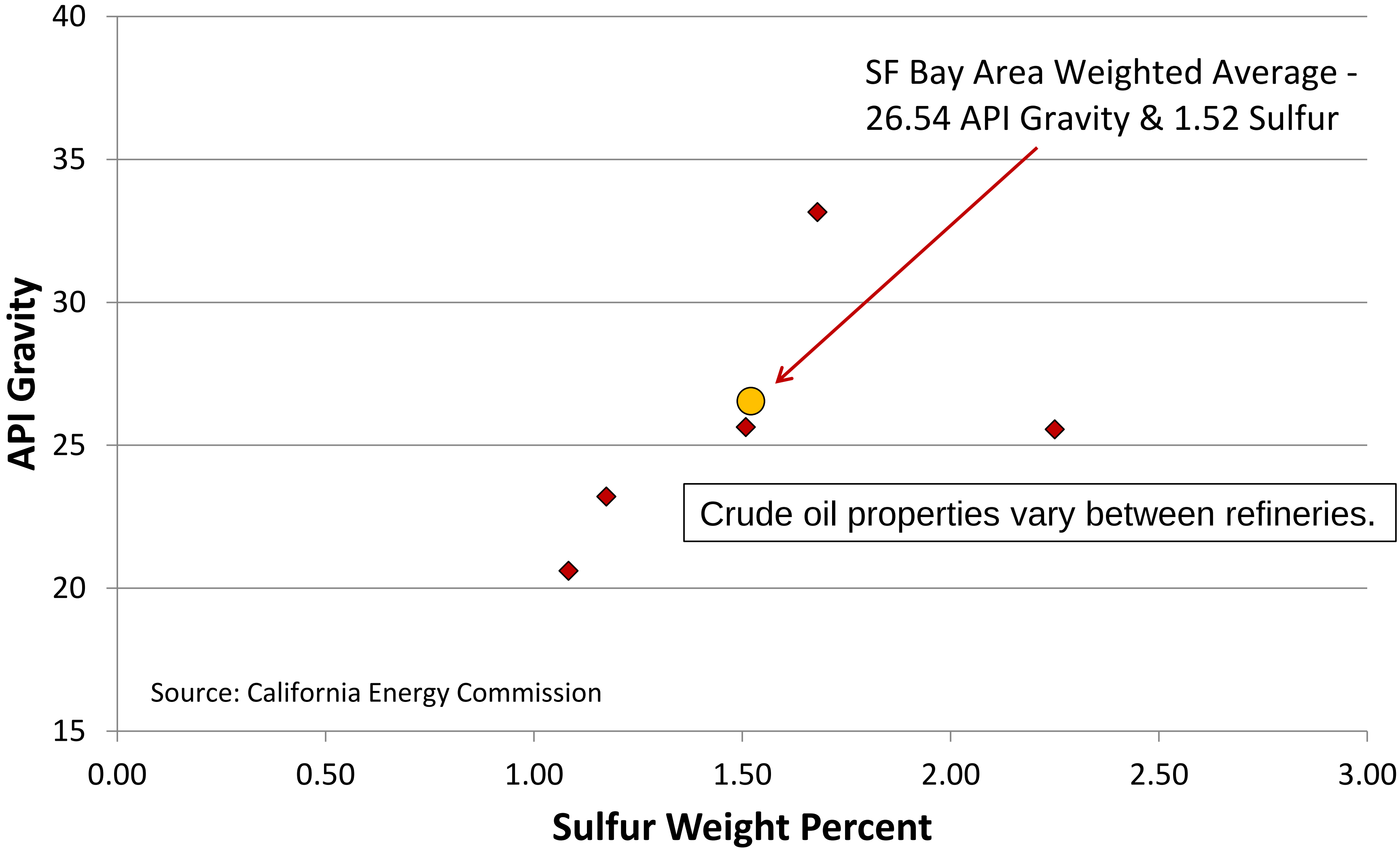


Significant variation in yield of petroleum products, after initial distillation step, necessitates further refining to modify hydrocarbons to end up with sufficient ratios of gasoline, diesel fuel and other compounds that will meet targeted refined fuel sales volumes.

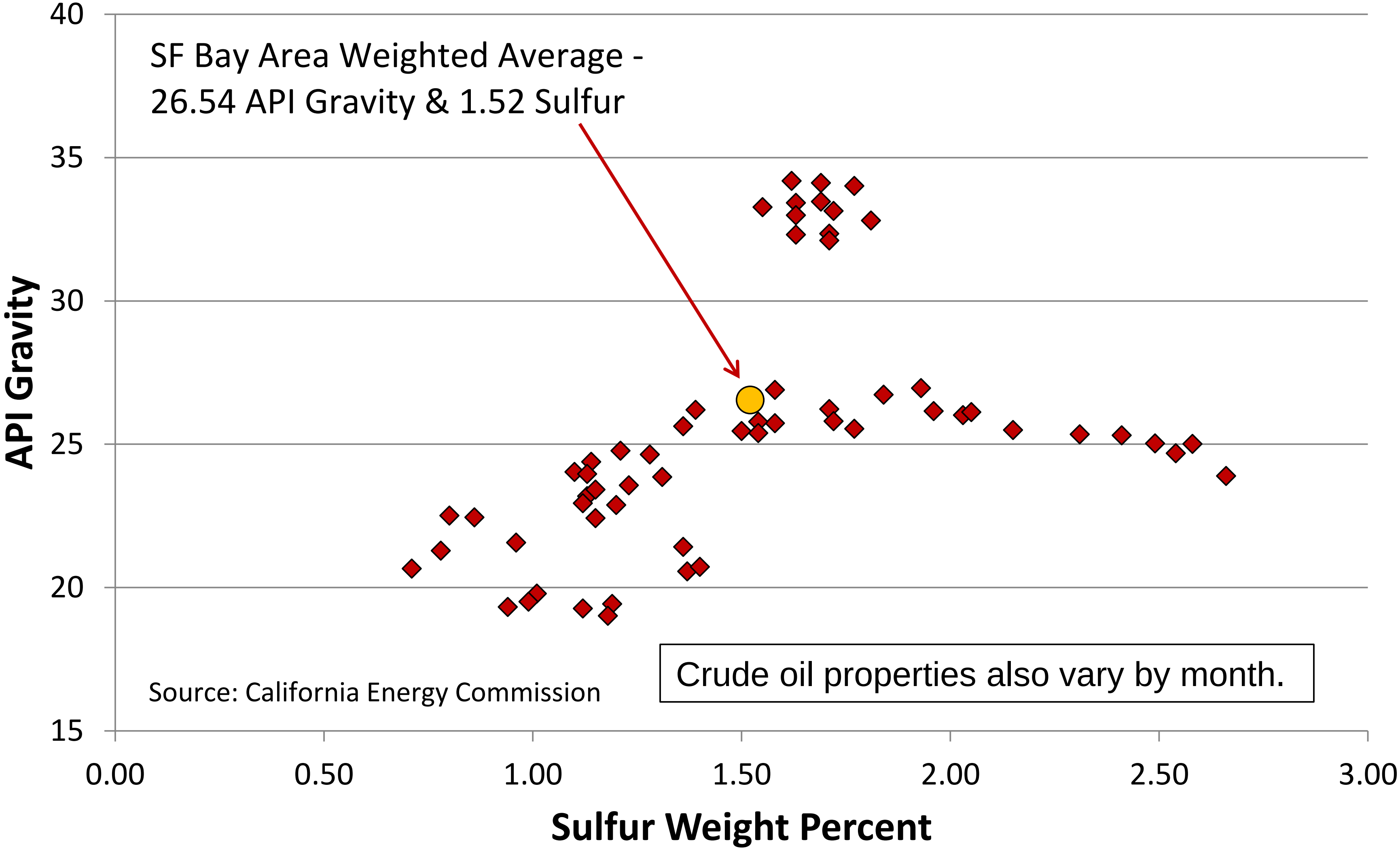
SF Bay Area Refineries Crude Oil Properties 2006-2015



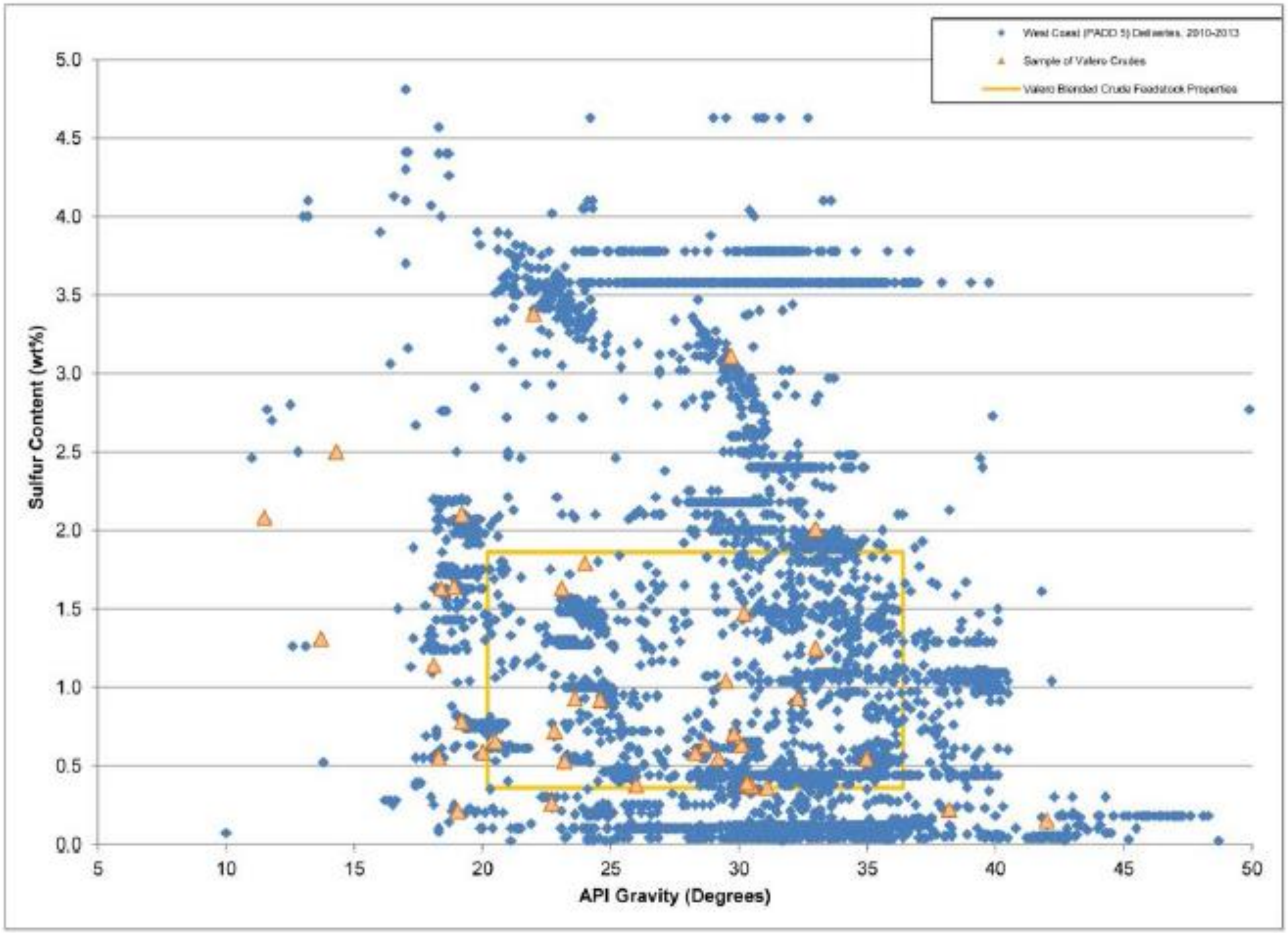
SF Bay Area Refineries
Annual Crude Oil Properties - 2015



SF Bay Area Refineries
Monthly Crude Oil Properties - 2015

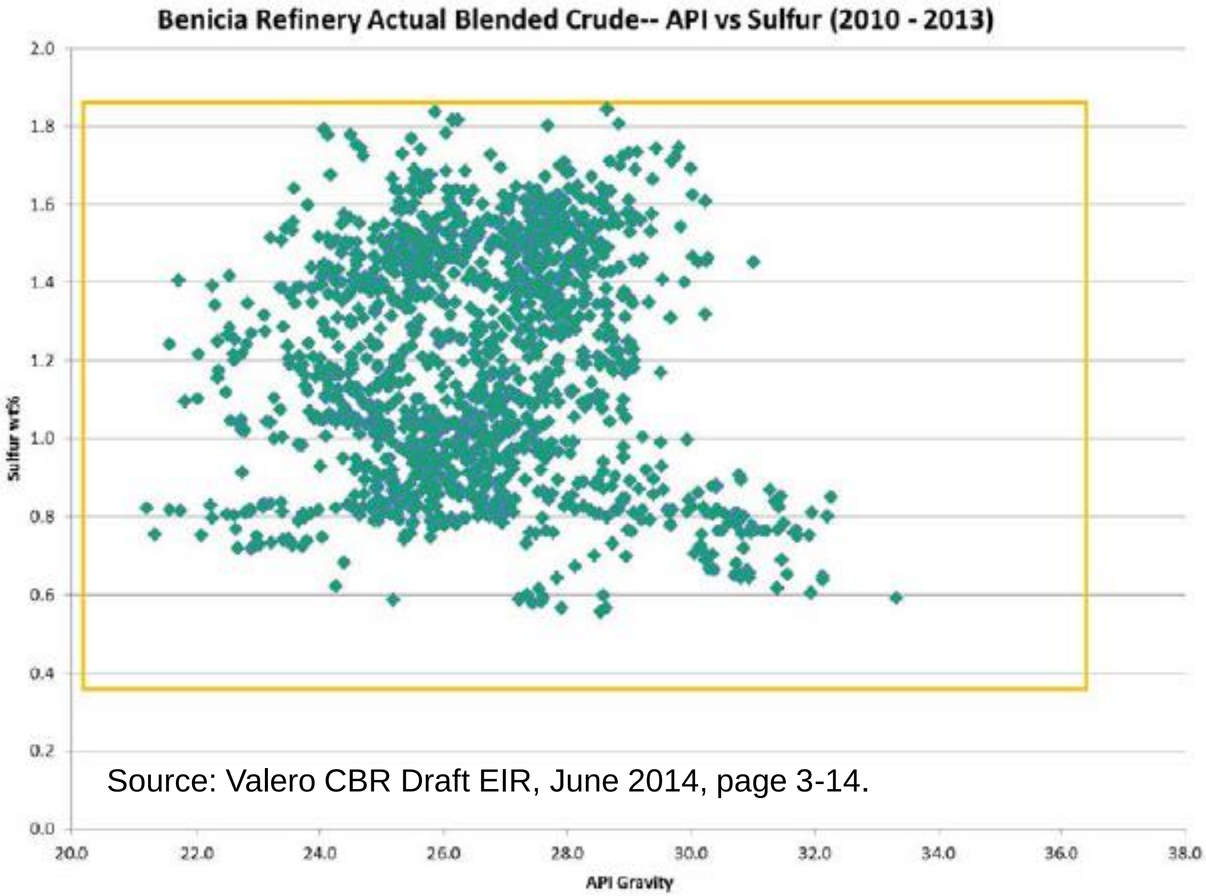


Variability of Crude Oil – West Coast



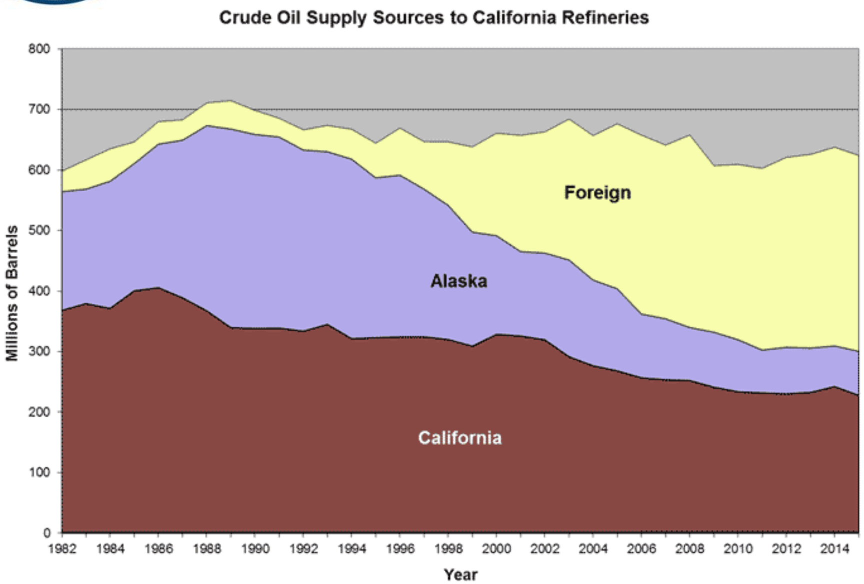
Source: Valero CBR Draft EIR, June 2014, page 3-13.

Refiners Blend Crude Oil



This practice enables receipt of a more diverse selection of crude oils to maximize operational and economic flexibility.

Importance of Blending



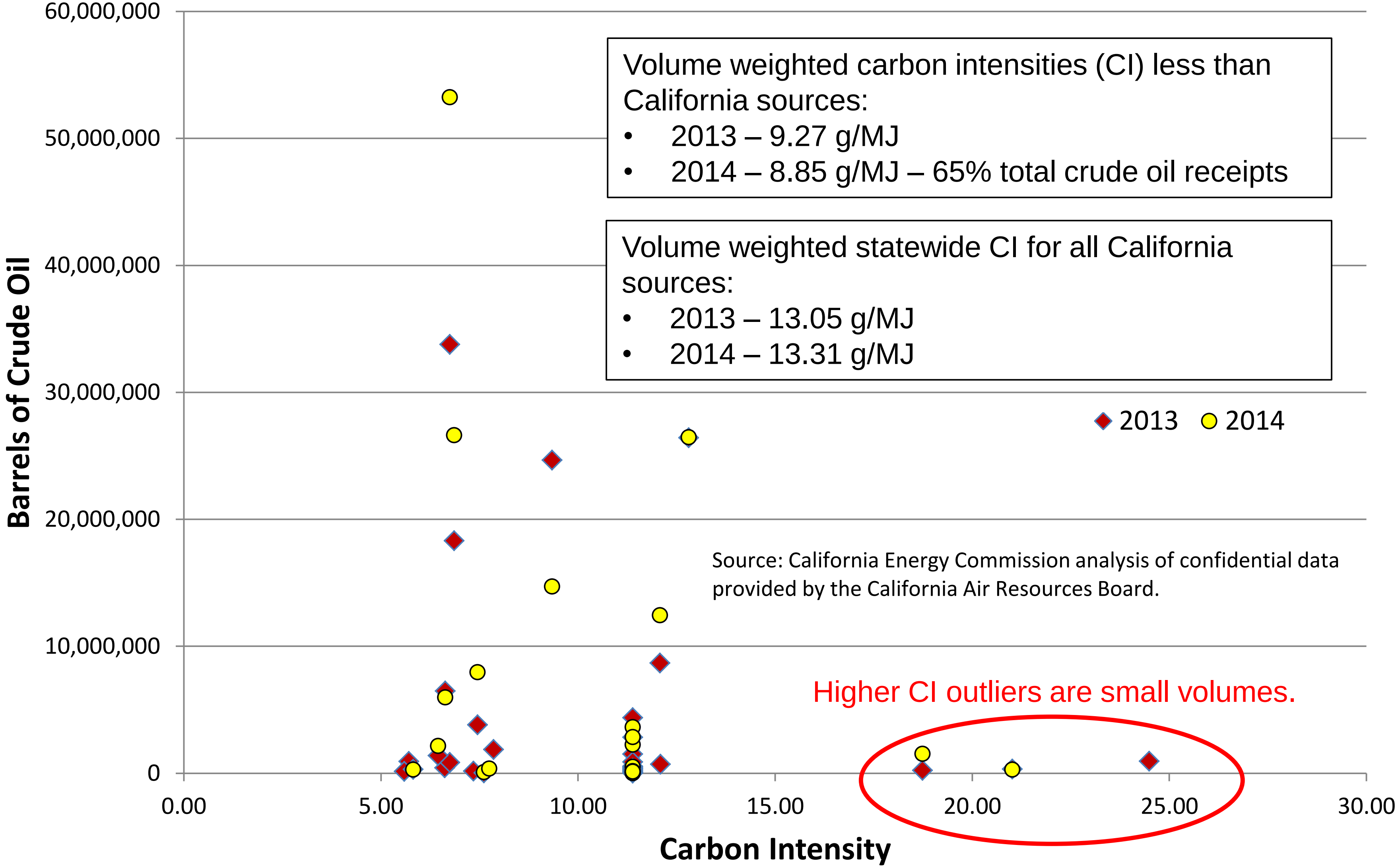
ANS BLENDING Table 1

	55% Bakken; 45% WCS	ANS	Difference
Gravity, °API	32.1	32.1	—
Sulfur, wt %	1.4	0.9	0.5
Total acid no., mg KOH	0.6	0.1	0.5
Liquid volume yields			
C_4-, %	3	4	–1
Naphtha, %	26	26	—
Kerosine-diesel, %	27	27	—
Gas oil, %	28	27	+1
Resid, %	16	16	—

Source: Oil & Gas Journal.

- Alaska North Slope (ANS) oil production has been declining
- Source of oil for California refineries has dropped from 46 percent in 1991 to 12 percent by 2015
- Blending crude oils with different properties can produce “look-alike” mixtures that mimic the product yields of crude oils that are having to be replaced
- Flexibility of crude oil supply options increases capability to maintain stable refinery operations

SF Bay Area Refineries - Crude Oil Carbon Intensity Non-California Sources



Volume weighted carbon intensities (CI) less than California sources:

- 2013 – 9.27 g/MJ
- 2014 – 8.85 g/MJ – 65% total crude oil receipts

Volume weighted statewide CI for all California sources:

- 2013 – 13.05 g/MJ
- 2014 – 13.31 g/MJ

Source: California Energy Commission analysis of confidential data provided by the California Air Resources Board.

Additional Q & A

Fort Point Historic Site and Golden Gate Bridge, San Francisco, CA 9-5-2010

Gregg Karras

Communities for a Better Environment

Presentation and Discussion:

Perspectives on Efficacy of GHG Caps at Local Refineries

Bay Area refinery “caps” proposal: Rule 12-16

- Introduction
- Environmental setting
- Oil quality impact mechanisms and scale
- Key trends

Communities for a Better Environment (CBE)
Greg Karras, Senior Scientist

Presented at the 25 April 2016 Meeting of the Bay Area Air Quality Management District Advisory Council, 939 Ellis St., San Francisco

Environmental Justice affirms the right of all workers to a safe and healthy work environment without being forced to choose between an unsafe livelihood and unemployment.

Principles of Environmental Justice, 1991; principle 8.

Description: A numeric limit on annual mass emission rate of greenhouse gases (CO_2e) & particulate matter (condensable + filterable PM, NO_x, and SO_x), to be applied to each refining facility, based on maximum-year actual facility emissions reported from 2011–2013.

Supporters on record:

CBE, USW Local 5, and 22 other community, environment, academic, environmental justice, climate protection, &/or labor union groups

Opponents on record:

Oil companies operating Bay Area refineries and their trade associations WSPA and CEEB

Galileo Galilei
(1564-1642)

Our world is not flat but circles the sun, and I should say so.

What could go wrong?

ENVIRONMENTAL SETTING

Technology pathway to stabilize climate at ≤ 2 ºC is still feasible,* but (among other things) we must by 2050:

- Electrify transportation while de-carbonizing electricity;
- Displace existing carbon-intensive technologies; and
- Account for infrastructure inertia to avoid “dead ends.”

* *See* e.g., Williams et al. (2011), (2015).

Rank of the Los Angeles area among the largest oil refining centers in Western North America: 1

Rank of the Bay Area area among the largest oil refining centers in Western North America: 2

From *Oil & Gas Journal* “Worldwide Refining Survey.”

Global post-tax oil subsidies in 2015: $1.5 trillion

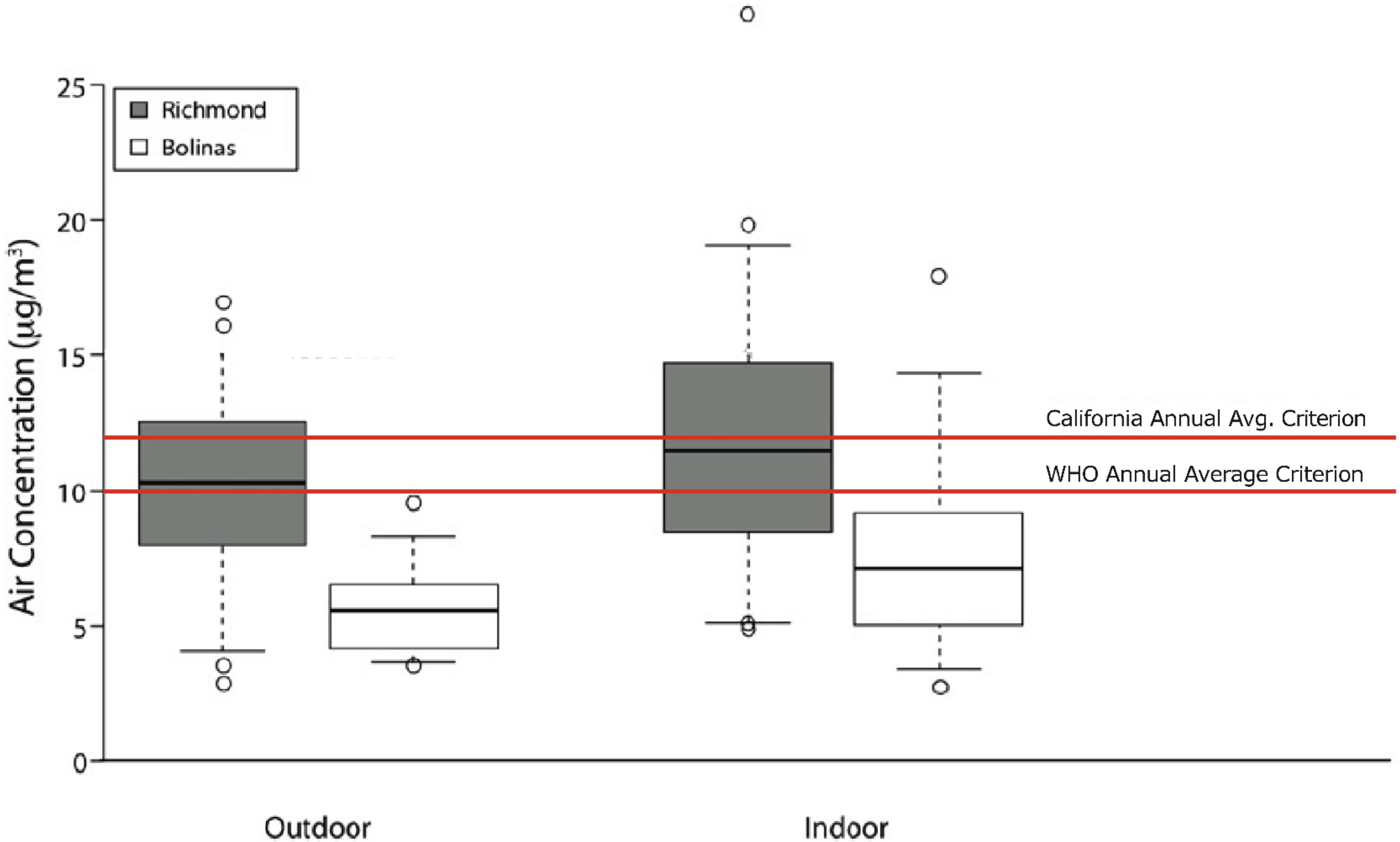
Percentage of these oil subsidies that
is accounted for by climate impacts: 14 %

Percent accounted for by local air pollution: 20 %

From *How Large Are Global Energy Subsidies?;* International Monetary Fund (IMF), 2015.

Estimated deaths associated with air pollution in the Bay Area annually:	2,000–3,000
Rank of fine particulate matter among air pollutants causing these Bay Area deaths:	1
Rank of oil refining among the largest industrial sources of fine particulate matter in the Bay Area	1
Rank of refined products among the largest sources of fine particulate matter in the Bay Area	1

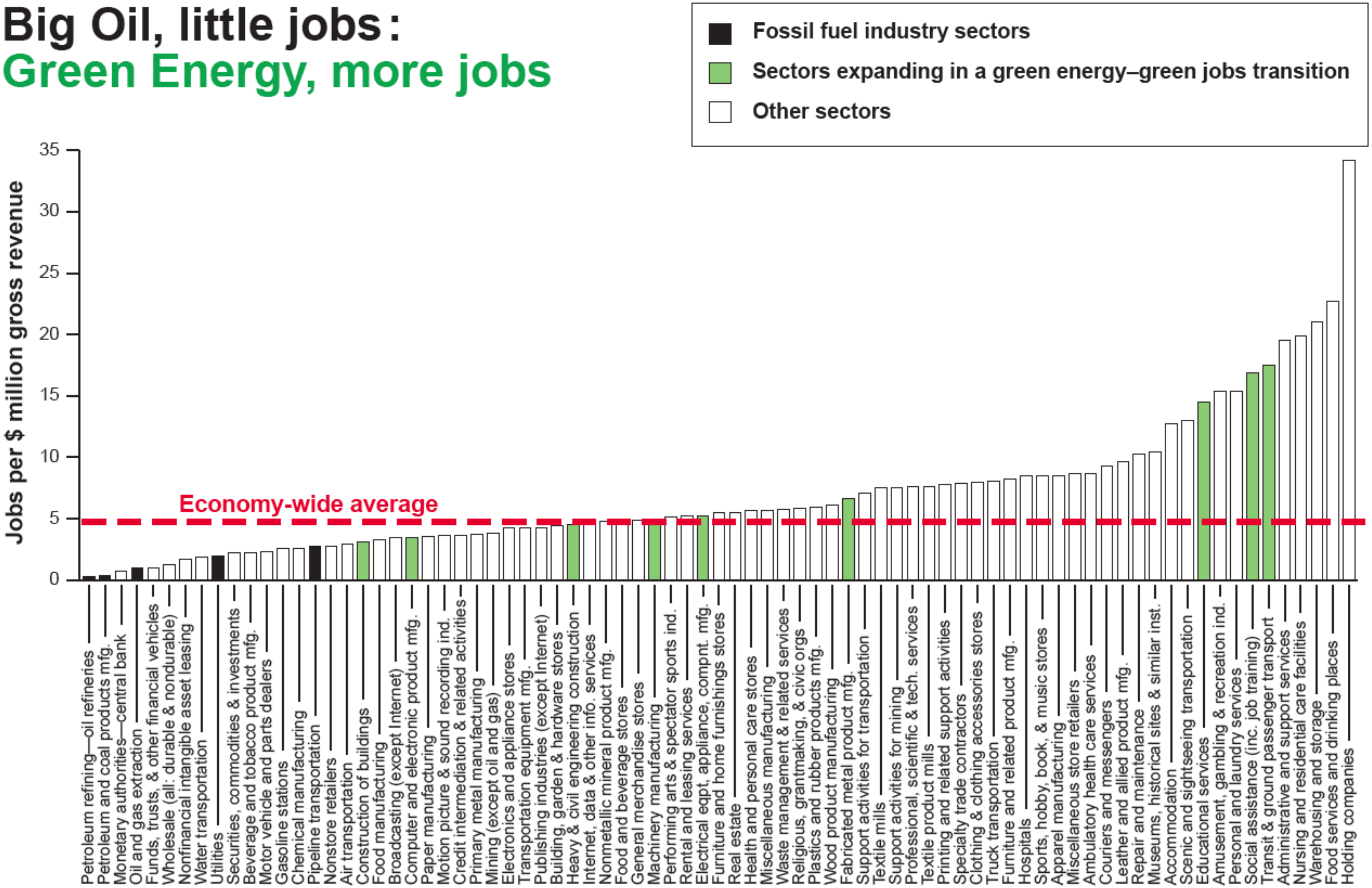
From BAAQMD, various dates.



Outdoor *and* indoor $PM_{2.5}$ air concentrations: refinery-impacted (shaded) and control (plain) sites; Bay Area in Summer, 2006.

Boxes are interquartile ranges; black lines in boxes are medians; dashed vertical lines are 5th and 95th percentiles; circles are extreme data points. (CBE Att. 44.)

Big Oil, little jobs:
Green Energy, more jobs

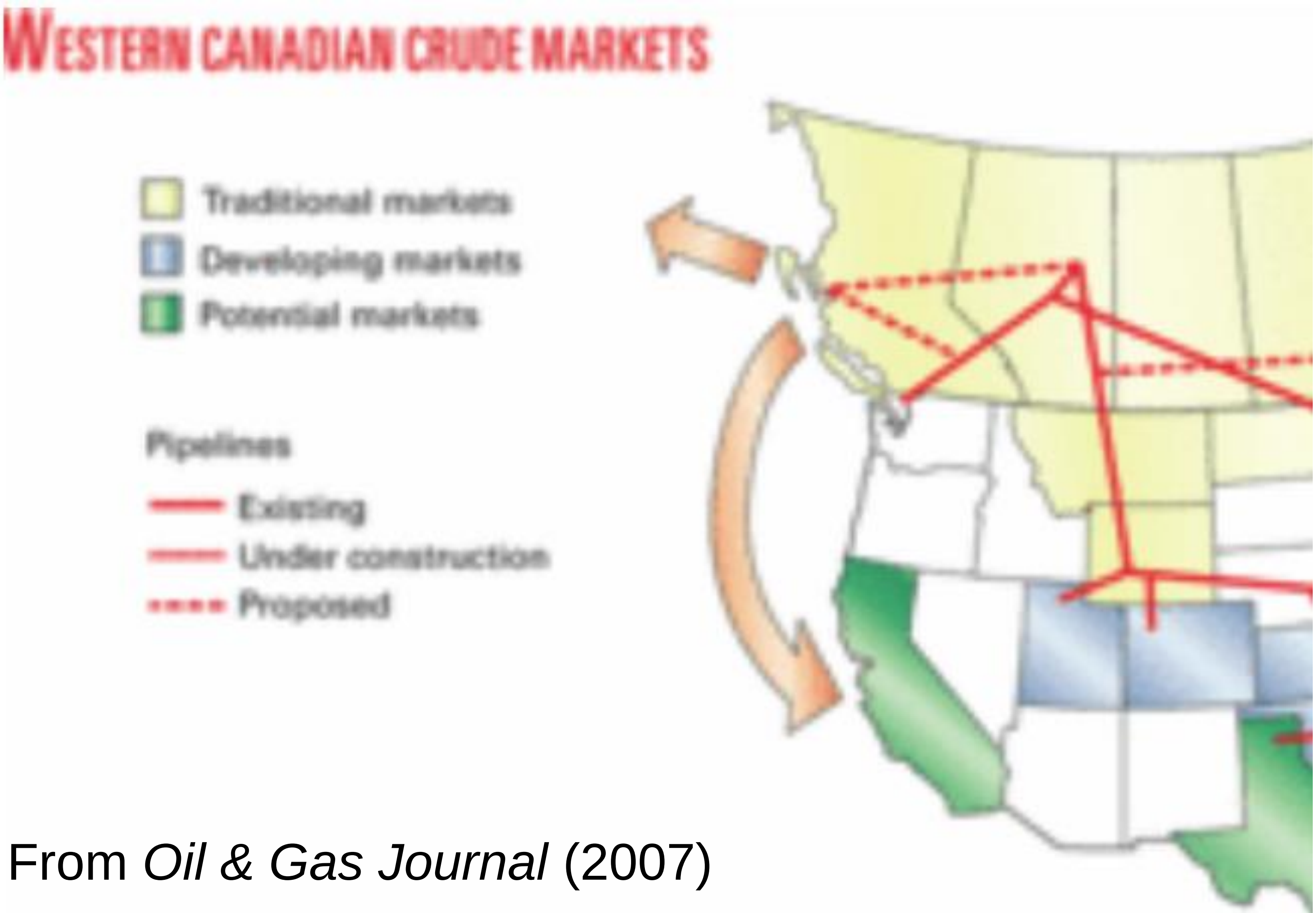


Paid employees per $ million sales, shipments, receipts, revenue, or other business done. Averages for all sectors in California, 1992–2007. Data from the U.S. Census Bureau, U.S. Economic Census taken in 1992, 1997, 2002 and 2007. Chart by Communities for a Better Environment (CBE), December 2011.

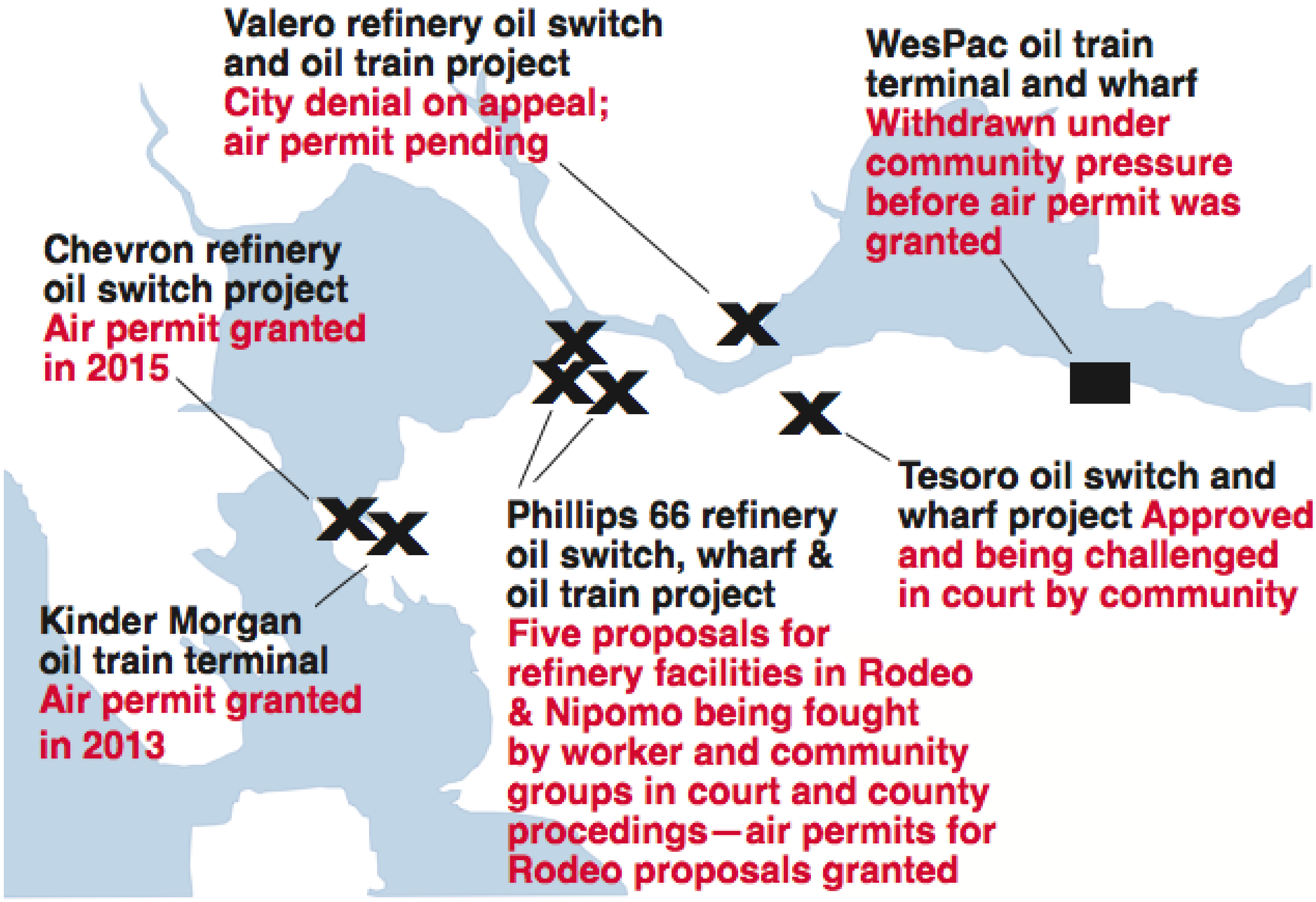
DEAD END TO AVOID: New capital commitments to tar sands oil (“unconventional oil”) infrastructure.

“We show that development of resources in the Arctic and any increase in unconventional oil production are incommensurate with efforts to limit average global warming to 2 ºC.”

From McGlade and Ekins, 2015. The geographical distribution of fossil fuels unused when limiting global warming to 2 ºC. *Nature;* DOI: 10.1038/nature14016.

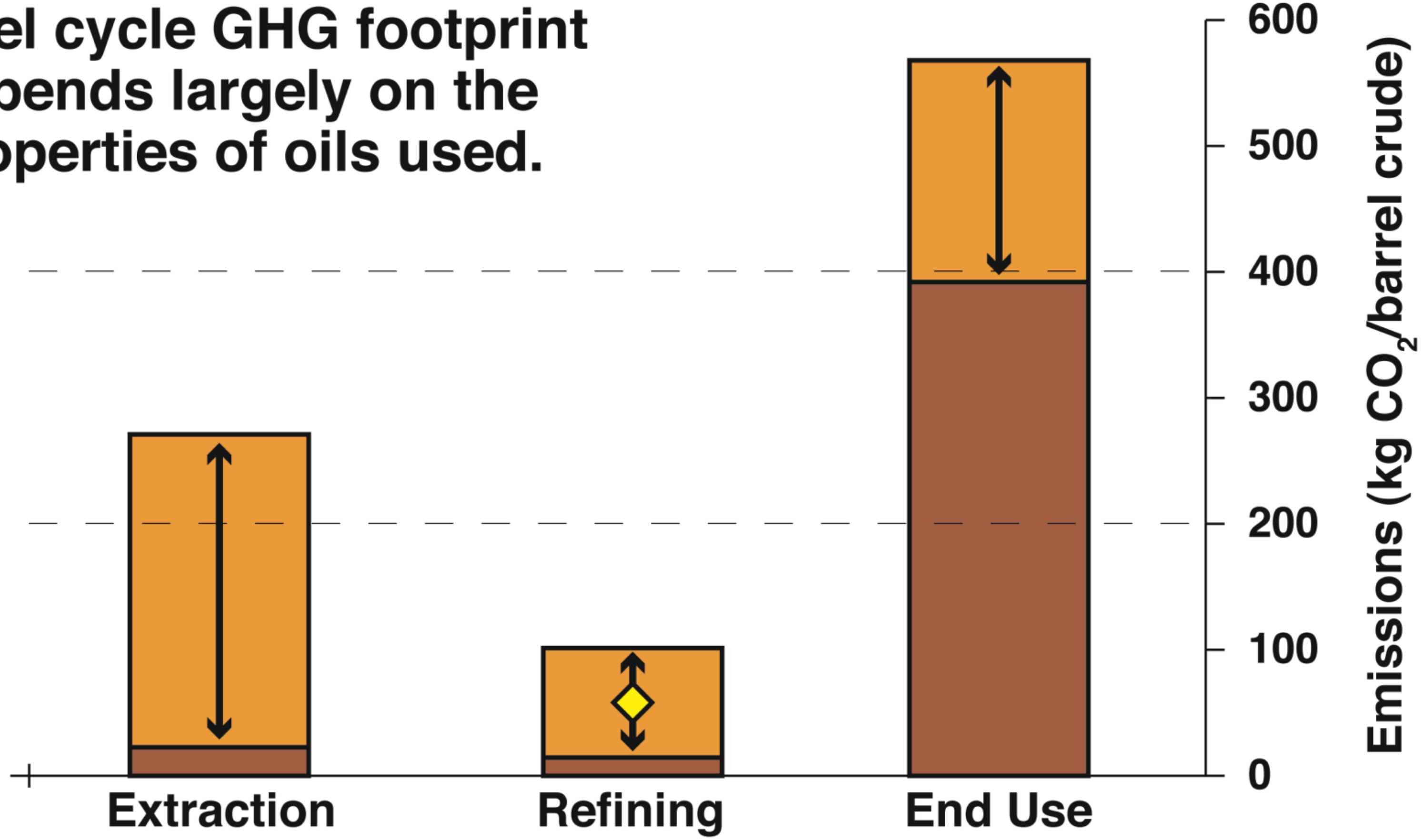


From *Oil & Gas Journal* (2007)



Some oil infrastructure proposals from 2012 to present.

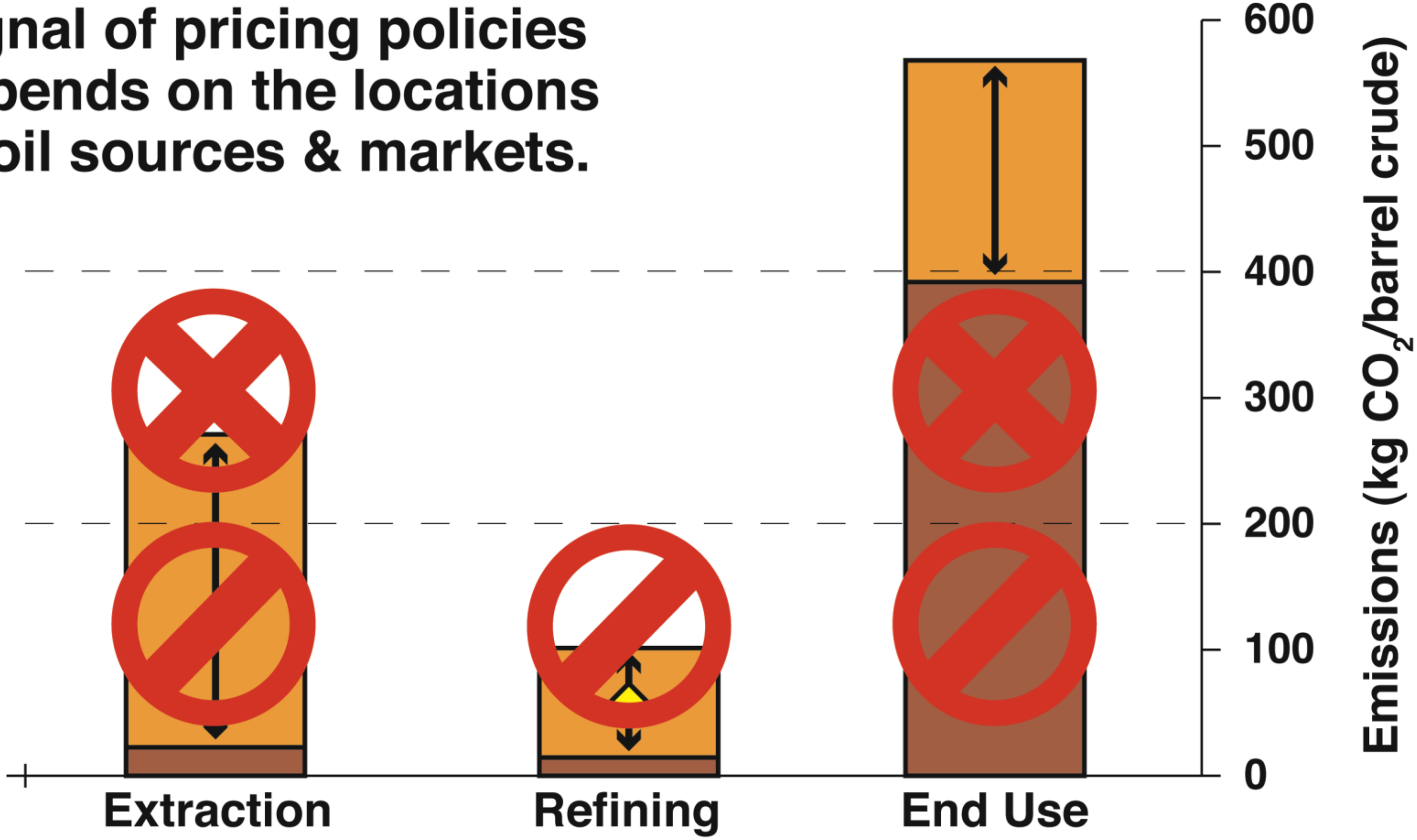
Fuel cycle GHG footprint depends largely on the properties of oils used.



Variance related to oil quality from Gordon et al., 2015. *Know Your Oil;* Carnegie Institute. Transport to refinery and end use included in upstream (extraction) and end-use columns.

Bay Area refineries average from Karras, 2010. *Env. Sci. Technol.*

Signal of pricing policies depends on the locations of oil sources & markets.



Exempt from LCFS when oil is used to to make gasoline & diesel that are sold out of the state.

Exempt from LCFS & cap-and-trade when these fuels are made from imported oil & are sold out of state.

"All Bay Area refineries … none of these facilities have overall mass emission limits that apply to the entire refinery."

Quoted from BAAQMD's 30 May 2012 *Regulatory Concept Paper, Petroleum Refining Emissions Tracking Rule.*

REFINERY FEEDSTOCK QUALITY IMPACTS, MECHANISMS AND SCALE

Pollutant pass-through impacts example

Process severity impacts example

Process energy impacts examples

Industry-level example of emission impact scale

Refinery-level analysis requires more detailed data

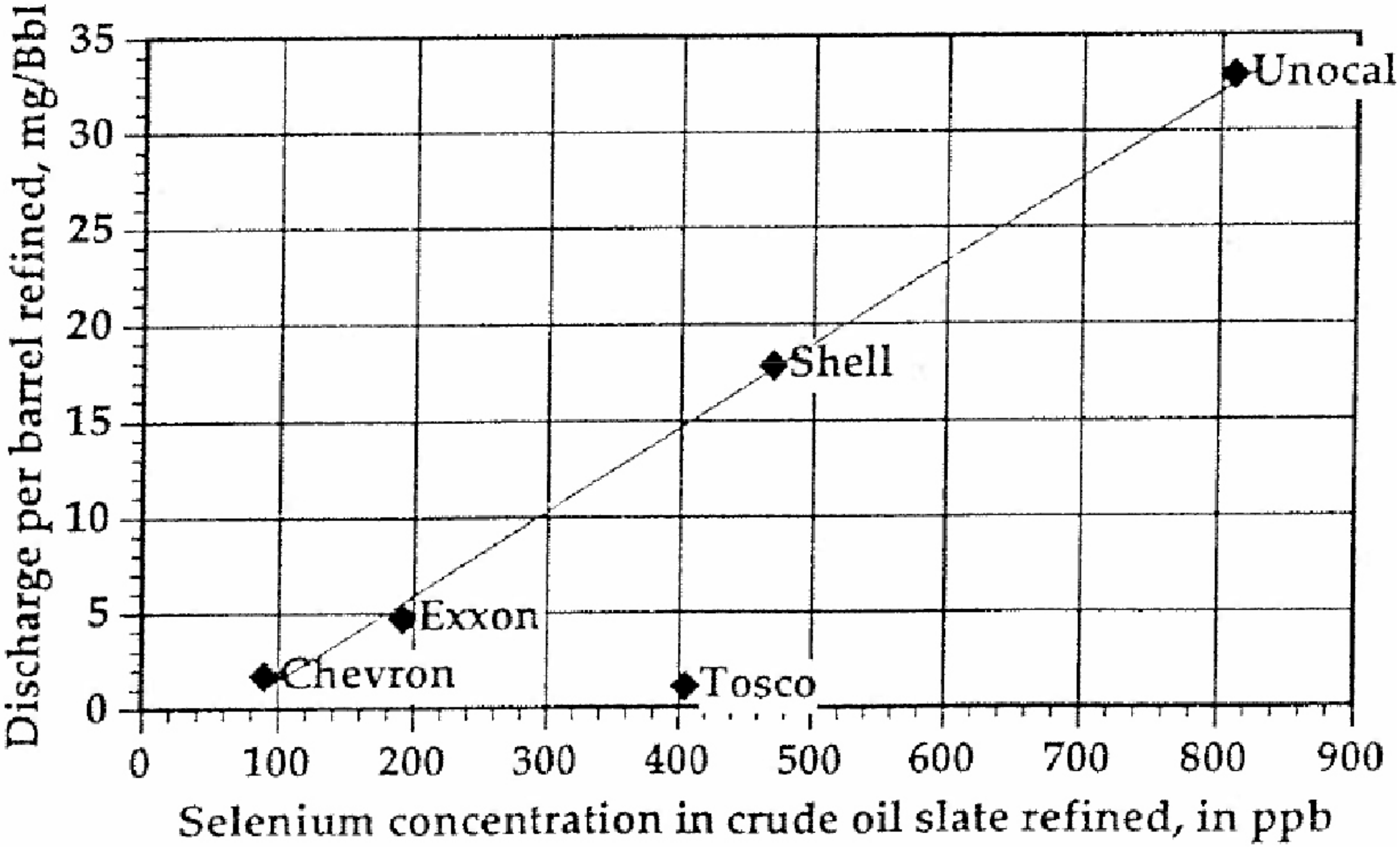
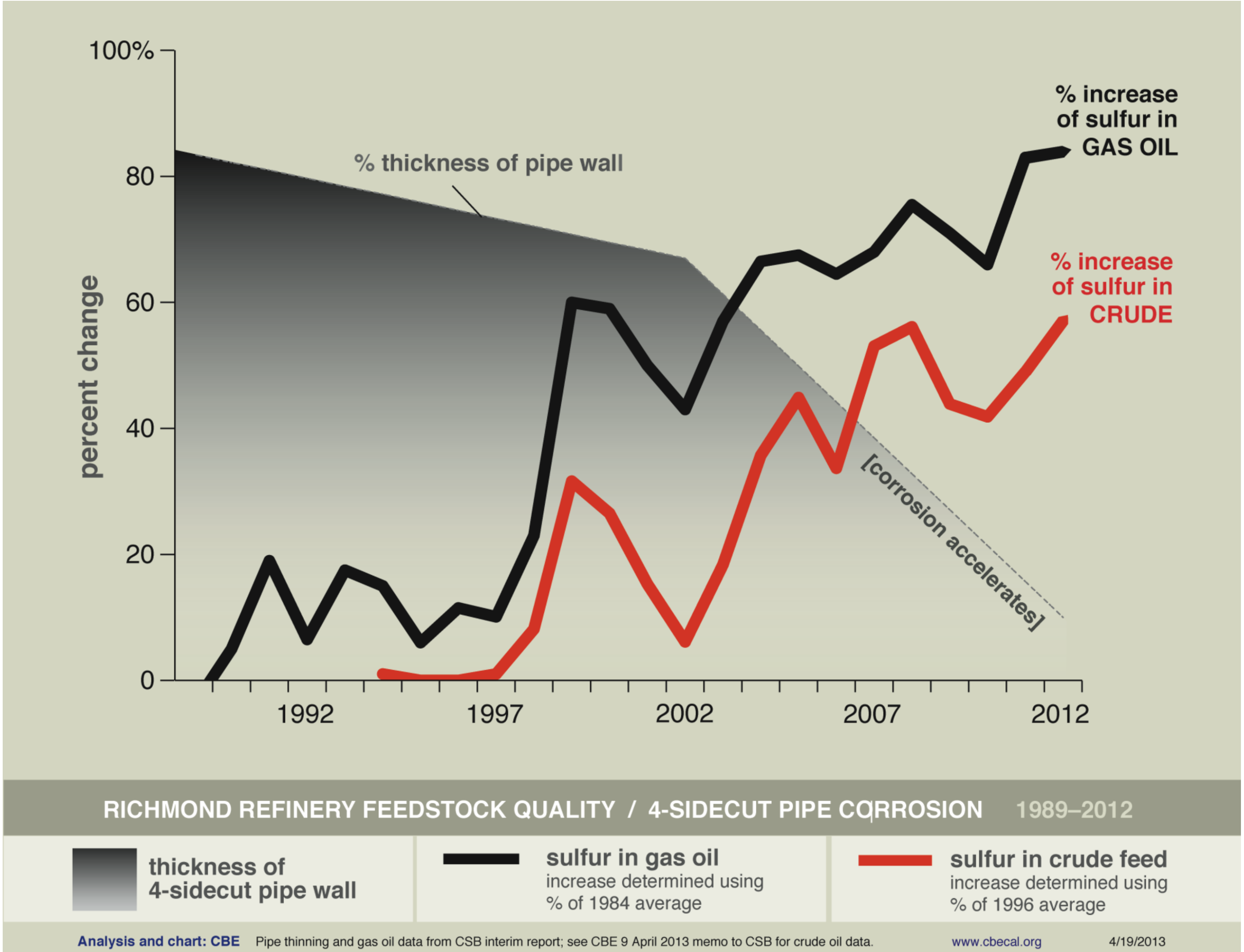
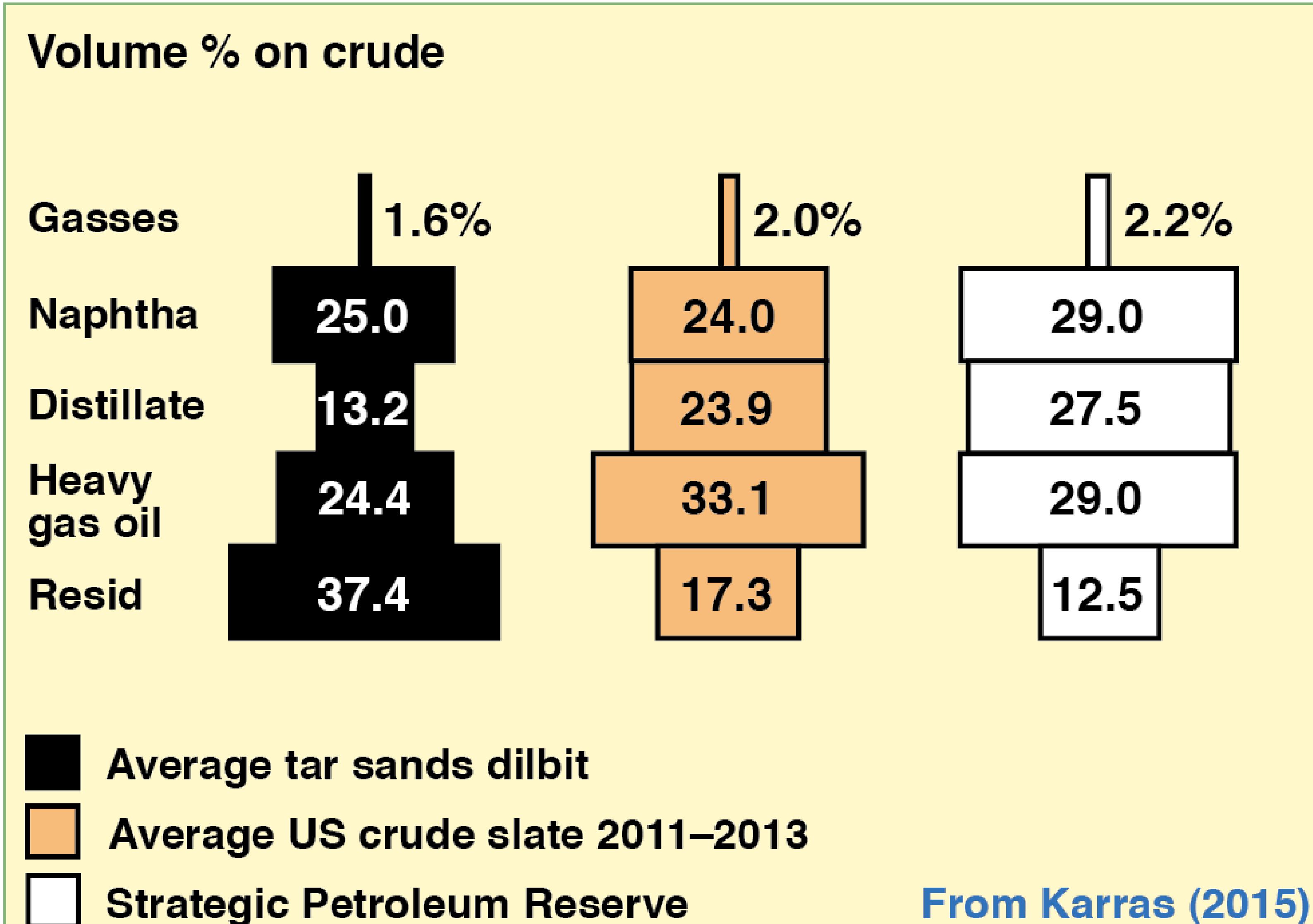
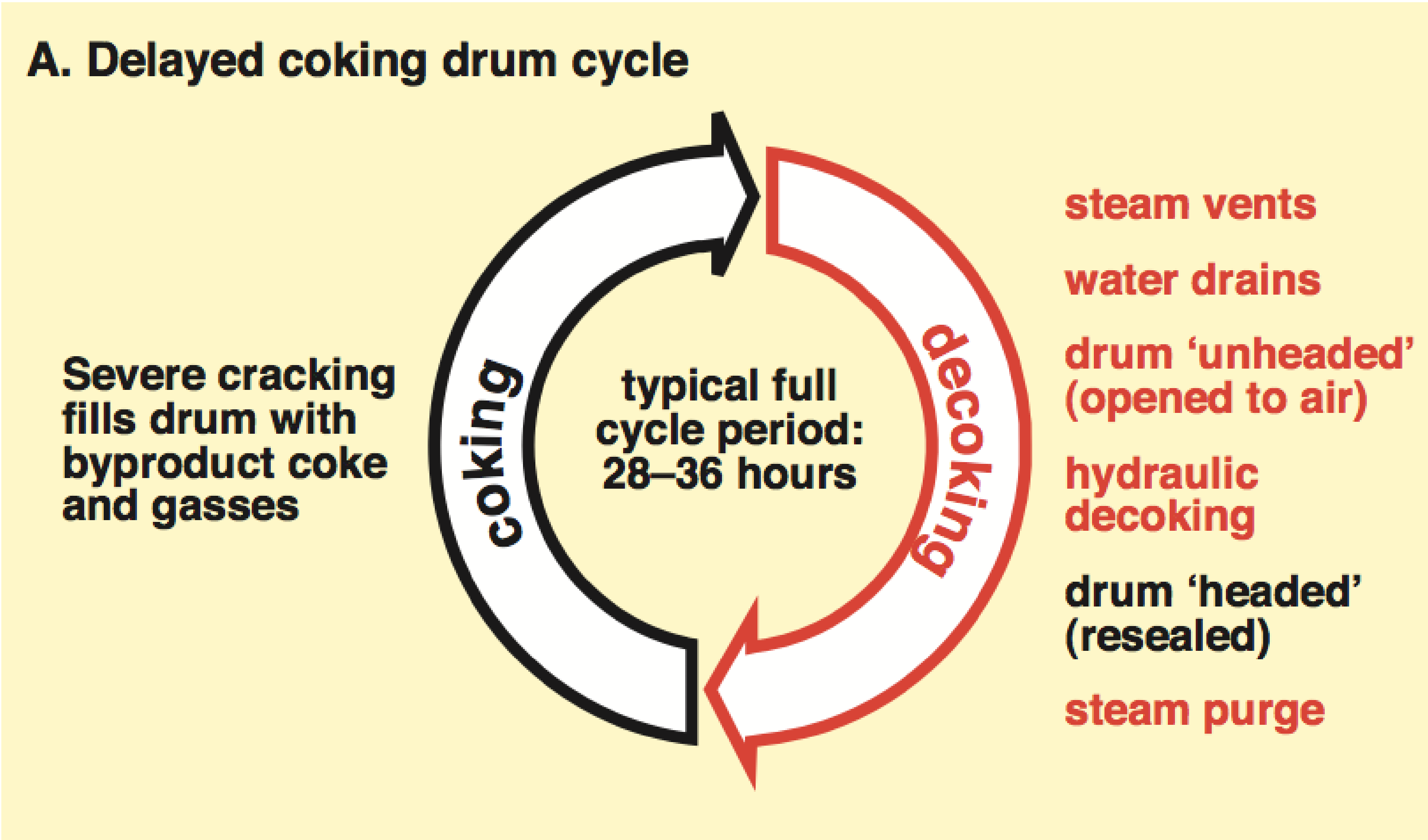


Chart from *Dirty Crude;* CBE Report No. 94-1. CBE, 1994.

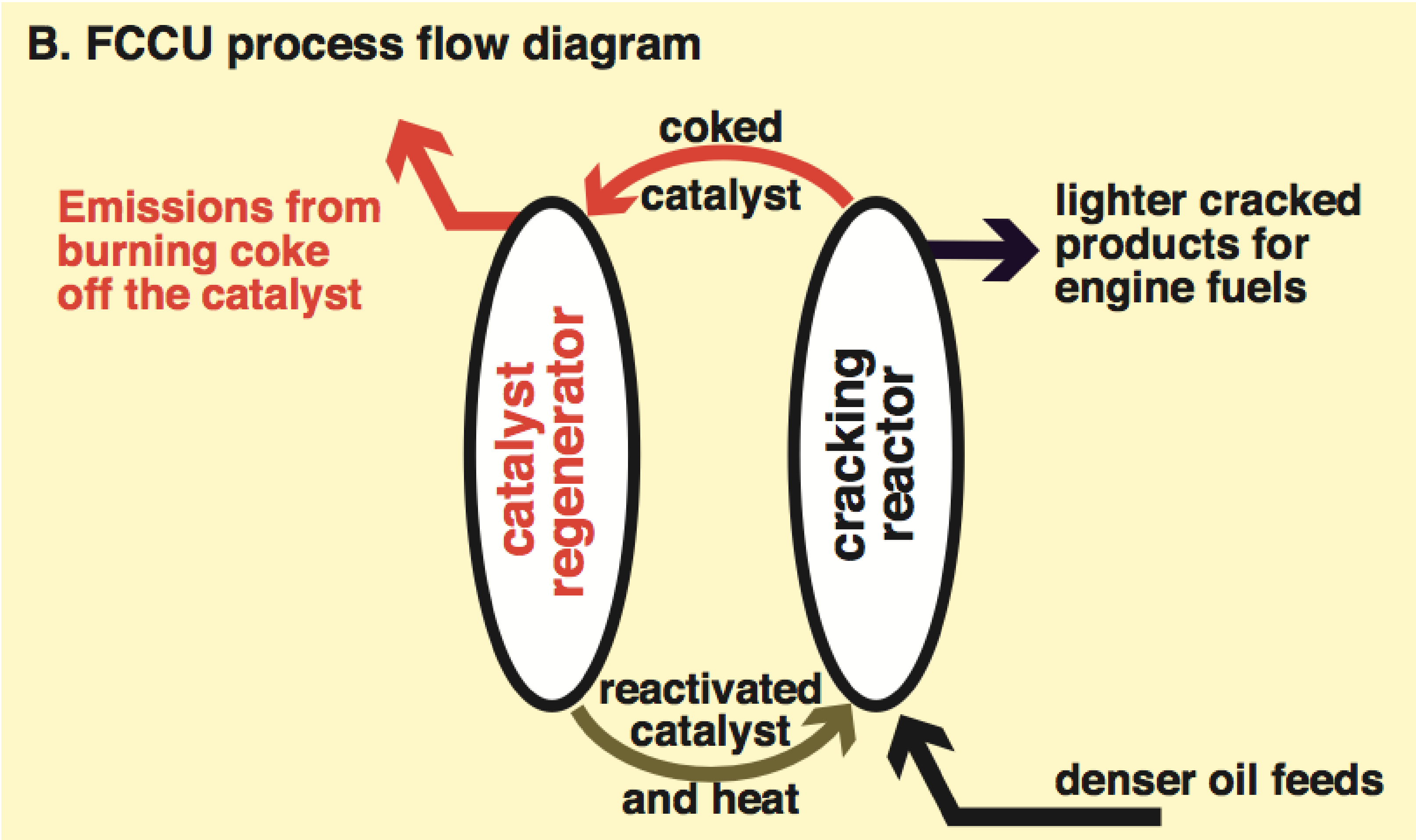

100%
80
60
40
20
0
percent change
1992
1997
2002
2007
2012
% thickness of pipe wall
% increase of sulfur in GAS OIL
% increase of sulfur in CRUDE
[corrosion accelerates]
RICHMOND REFINERY FEEDSTOCK QUALITY / 4-SIDECUT PIPE CORROSION 1989–2012
thickness of 4-sidecut pipe wall
sulfur in gas oil
increase determined using % of 1984 average
sulfur in crude feed
increase determined using % of 1996 average
Analysis and chart: CBE
Pipe thinning and gas oil data from CSB interim report; see CBE 9 April 2013 memo to CSB for crude oil data.
www.cbecal.org
4/19/2013



From Karras (2015).

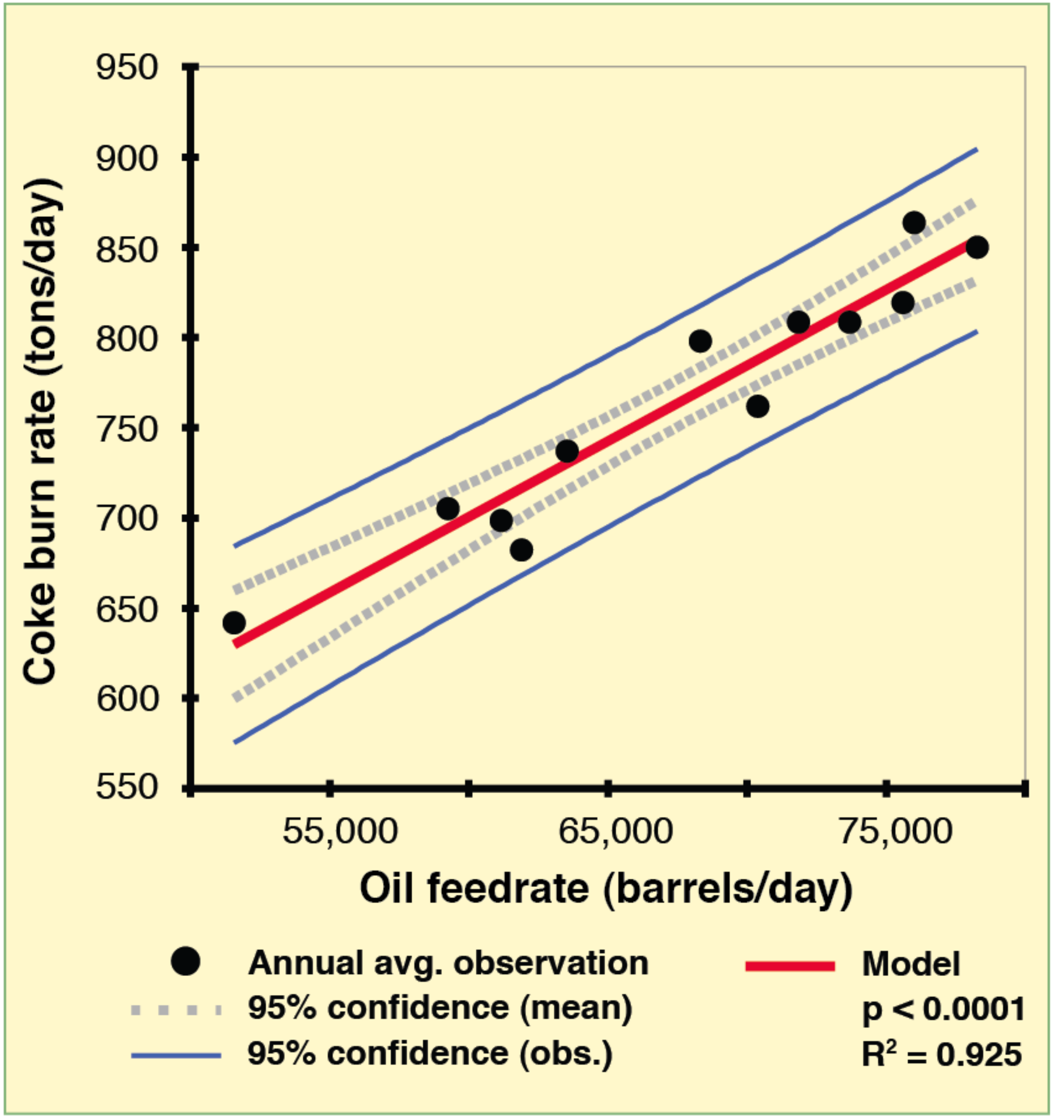


Coking process rate is related to resid distillation yield and engine fuels targets. Figure from Karras (2015).



FCCU rate is related to resid and gas oil distillation yield, coker yield, and gasoline production. Karras (2015).

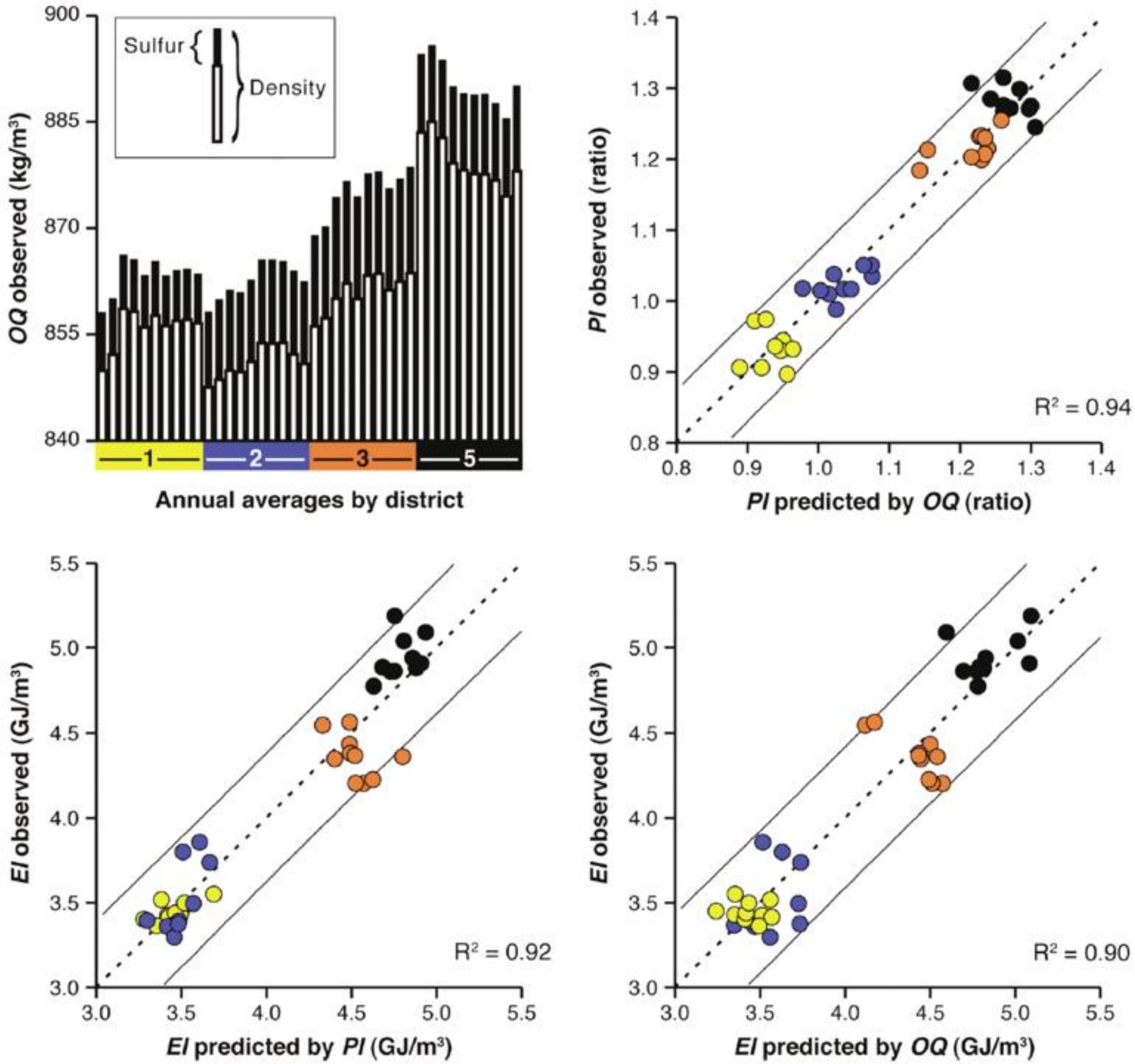
Increase in coke burned by the catalytic cracker at Chevron in Richmond as its heavy oil feed rate increased following an expansion of the unit's capacity in the 1990s.



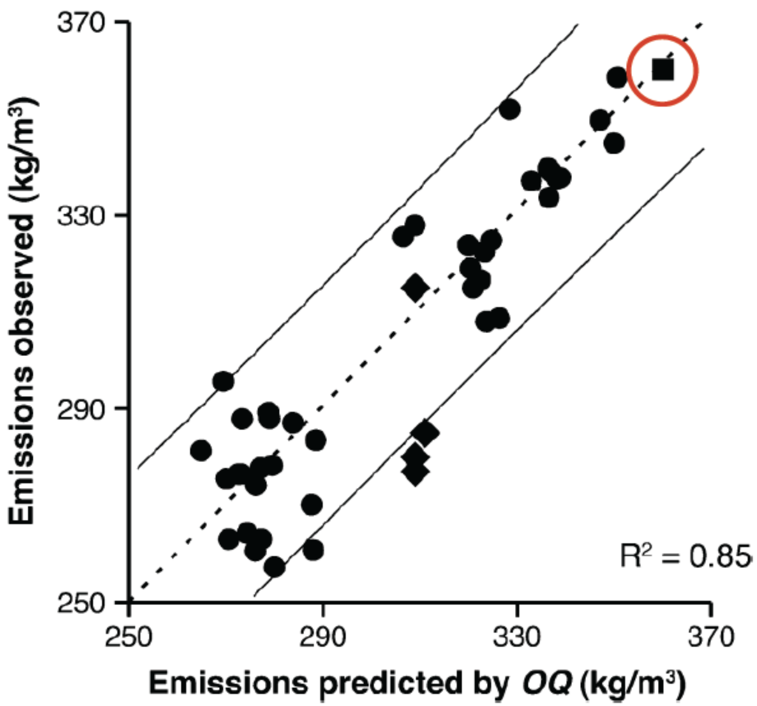
From Karras, 2015.

Example of the project's significant oil quality impacts: hydrogen deficiency.			
	Density (°API)	Sulfur (wt. %)	Hydrogen (lbs/bbl)
Current oils the project could replace			
50% Basra / 50% Lula (B/L) blend	30.0	1.46	38.8
Alaska North Slope crude (ANS)	31.4	0.85	39.0
Project-imported tar sands oil blends			
45% CL / 55% HSB (CL/HSB) blend	27.2	1.87	37.8
30% SH / 70% SSB (SH/SSB) blend	28.3	1.71	37.1
Crude feedstock change (hydrogen deficiency) from:			
replacing B/L blend with CL/HSB blend (lbs H_2/bbl)			–1.00
replacing ANS with SH/SSB blend (lbs H_2/bbl)			–1.90

In this example from testimony in a refiner's ongoing appeal of a Bay Area project denial, each lb of hydrogen deficiency could represent ≈ 10 lbs of CO_2 emission.



American Chemical Society (2010). ***OQ***: crude feed quality. ***PI***: refinery processing intensity. ***EI***: refinery energy intensity. Colors correspond to US PADD numbers at upper left of figure.



Total CO_2 emitted/m³ oil refined by Bay Area refineries (circled) was the highest observed (see vertical axis) and predicted by oil quality (horizontal axis) among U.S. refining regions, as of 2008.

FIGURE 3. Refinery CO_2 emission intensity observed versus predicted by oil quality. *OQ:* Oil quality. Black circles: District 1, 2, 3, or 5 annually, 1999–2008. Black diamonds: United States in 2002, 2005, 2006, 2007. Black square: San Francisco Bay Area in 2008. Diagonal lines bound the 95% confidence of prediction for observations. R^2 value shown is for the comparison among districts and years.

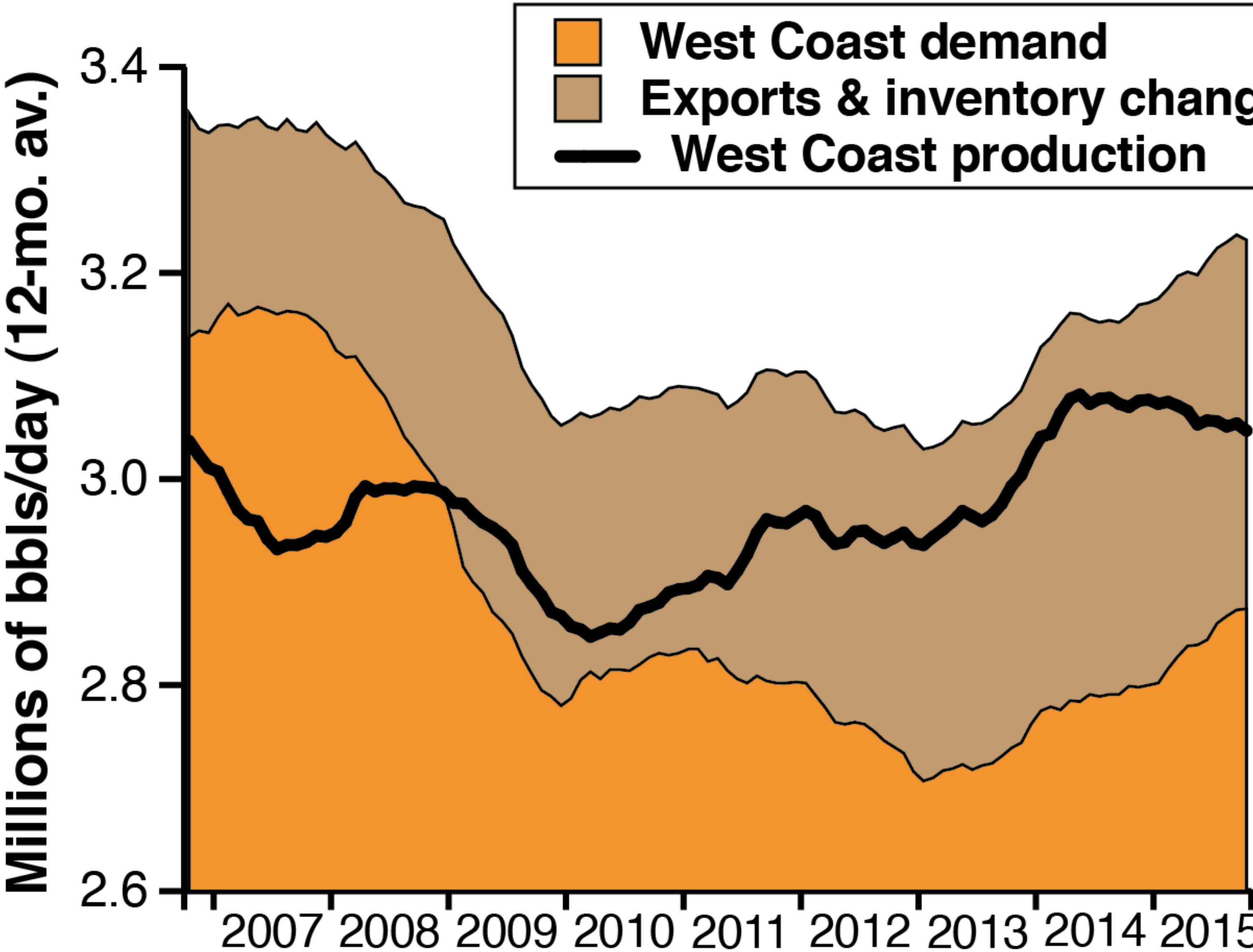
American Chemical Society, 2010. (Karras, 2010).

Reliable prediction of the emission impacts of a new oil feedstock <u>at the refinery level</u> (for an individual plant) may require more detailed data regarding:

- Refining properties of oils and oil feedstock blends;
- Process-level parameters & material & energy inputs;
- The types and amounts of refined products targeted &
- Existing & planned abatement and safety measures.

Note that some of this data is not presently being disclosed transparently by Bay Area refiners.

SOME KEY TRENDS

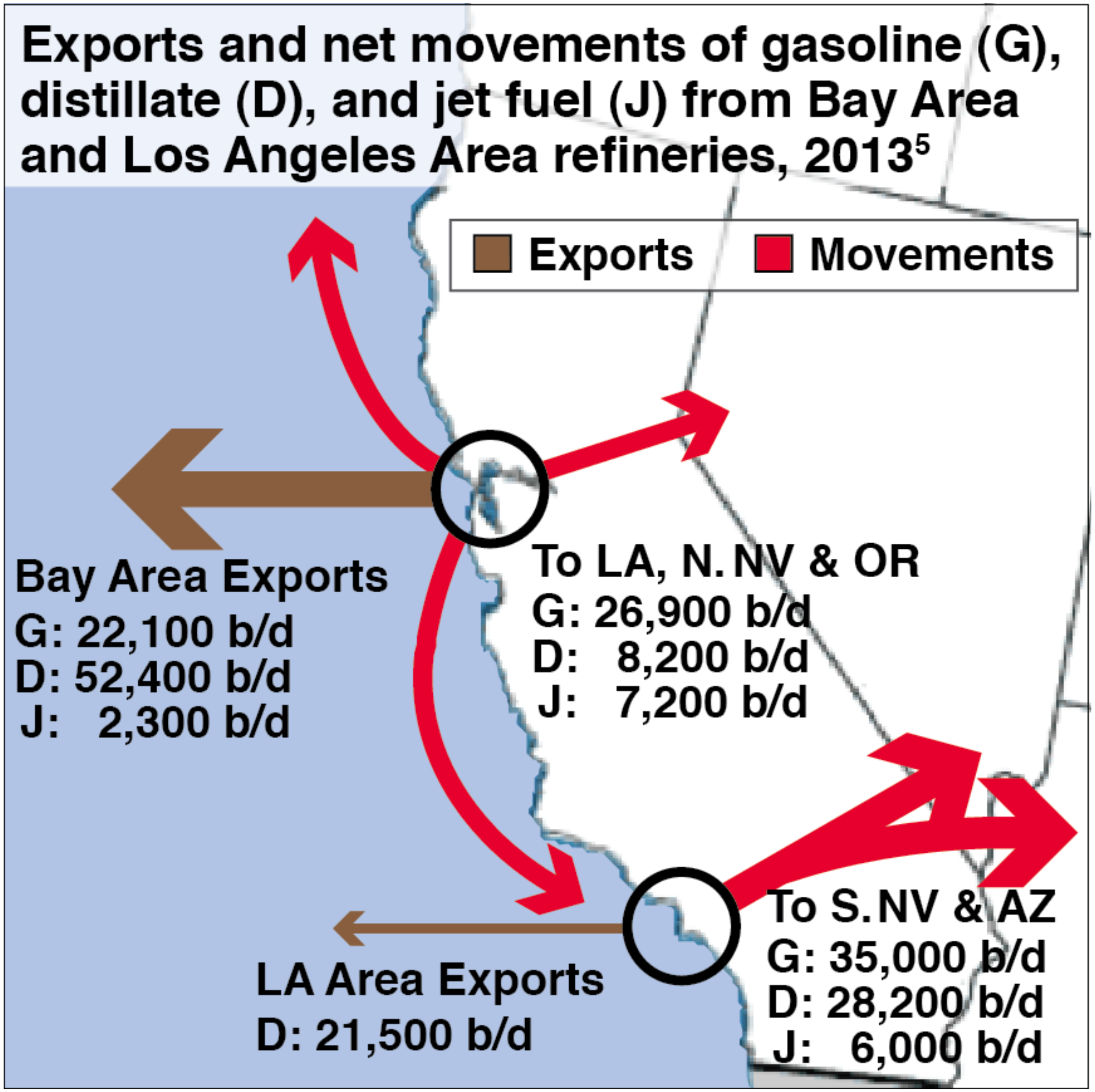


Data from U.S. Energy Information Administration; chart by CBE.

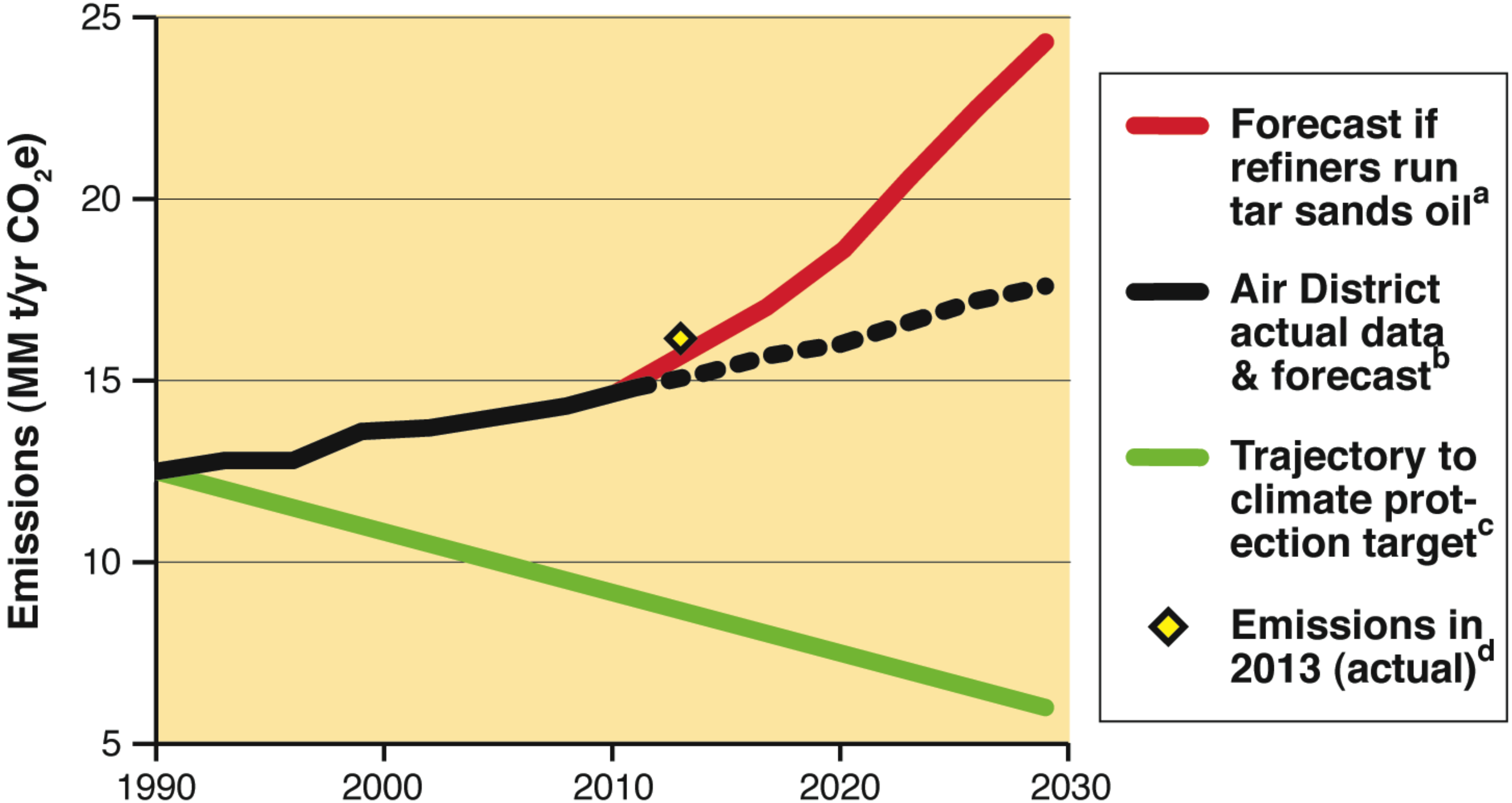
Bay Area refiners got more money exporting than other West Coast refining centers, 2014.

Refining Center	Exports in 2014
San Francisco Bay Area	$ 4,376,000,000
Los Angeles Area	$ 3,519,000,000
Puget Sound Area, WA	$ 1,369,000,000
Bakersfield Area, CA	$ 650,000,000
Other areas (AK & HI)	$ 290,000,000

Data from Brookings Institution.



Data from U.S. Energy Information Administration; map by CBE.



Refinery GHG emissions and forecasts, S.F. Bay Area, 1990–2029

[a]CBE *after* UCS (2011). [b]BAAQMD data (2010). [c]–80% from 1990 rate by 2050. [d]CARB data.

Lunch

Bill Quinn *and* Berman Olbaldia

California Coalition for Environmental and Economic Balance *and* Western States Petroleum Association

Discussion:

Perspectives on Efficacy of GHG Caps at Local Refineries

Gary Rubenstein

Sierra Research on behalf of CCEEB and WSPA

Presentation:

Perspectives on Efficacy of GHG Caps at Local Refineries

AGENDA: 6

The Efficacy of Greenhouse Gas Emission Caps at Local Refineries

Prepared for the
Bay Area Air Quality Management District Advisory Council
April 25, 2016

Presented by:
Gary Rubenstein
Sierra Research

What problem are we trying to solve?

- The efficacy of the establishment of GHG emission caps for San Francisco Bay Area refineries depends on the problem we are trying to solve, or the issue we are trying to address.
- "Efficacy" means the power to produce a desired result or effect. {http://www.merriam-webster.com/dictionary/efficacy}
- After reviewing the draft minutes of the last two Advisory Council meetings, I am unable to discern a specific desired result or effect that would be sought through individual refinery caps on GHG emissions.

What problem are we trying to solve? (cont'd)

- For the purpose of my presentation, I assume that the primary objective of a refinery cap on GHG emissions is to reduce direct and/or indirect GHG emissions from the production, transportation, and use of crude oil and liquid petroleum products.
- While there may be other, secondary objectives associated with such a regulation, my comments are principally focused on the efficacy of a refinery GHG cap to achieve the above primary objective.

Effective Policy Making

- A sub-cap on GHG emissions from refineries within an overarching state Cap-and-Trade Program does not reflect sound science or effective regulatory policy.
- Caps on GHG emissions from refineries:
  - Will have no effect on fuel demand
  - May result in higher fuel costs, local shortages
  - Will reduce the overall efficiency of the statewide Cap-and-Trade Program
  - Will not reduce statewide GHG emissions
  - Will not necessarily result in reductions in emissions of other pollutants or other benefits

Effect on Fuel Demand

- Refinery caps will have no effect on fuel demand, locally or statewide.
  - Fuel production is demand-driven, not vice-versa. (See, e.g., https://www.eia.gov/todayinenergy/detail.cfm?id=19191)
  - Refinery GHG caps will not reduce GHG emissions, or emissions of other pollutants, from the combustion of transportation fuels.
  - Refinery GHG caps will not reduce or eliminate crude-by-rail transport.

Fuel Costs and Local Shortages

- Refinery caps may result in higher fuel costs, local shortages.
  - GHG emissions at Bay Area refineries are currently limited by heat input limits on each combustion device.
    - To be meaningful, a sub-cap would need to be lower than the current effective limit, resulting in a reduction of existing refinery capacity.
  - Reduced local capacity will result in increased product imports from elsewhere in California, as well as from outside the state, with accompanying higher transportation costs and transportation emissions.

Fuel Costs and Local Shortages (cont'd)

- Reduced local refinery capacity may result in localized shortages, which could lead to:
  - long lines at service stations;
  - motorists driving farther to fill up; and
  - higher emissions of GHGs and other pollutants.

Reduced Efficiency of Cap-and-Trade

- Goals of the California Cap-and-Trade Program
  - "By establishing a limit for the program ***overall rather than for individual sources***, the cap-and-trade program gives sources flexibility to make the ***most cost-effective choices*** about when and how to reduce emissions." [emphasis added]

    http://www.arb.ca.gov/regact/2010/capandtrade10/capisor.pdf

- Refinery caps will reduce the efficiency of the overall statewide Cap-and-Trade Program by forcing GHG reductions to occur where they may not be most cost-effective, thereby increasing the overall cost of statewide GHG reductions. These costs would likely be passed onto consumers.

Reduced Efficiency of Cap-and-Trade (cont'd)

- On-site reductions are prioritized over more cost/effective reductions at other sites – thus increasing statewide compliance costs for the same level of emission control.
- These higher costs are passed through to the economy; in the case of transportation fuels, these higher costs have a regressive impact on low-income drivers.

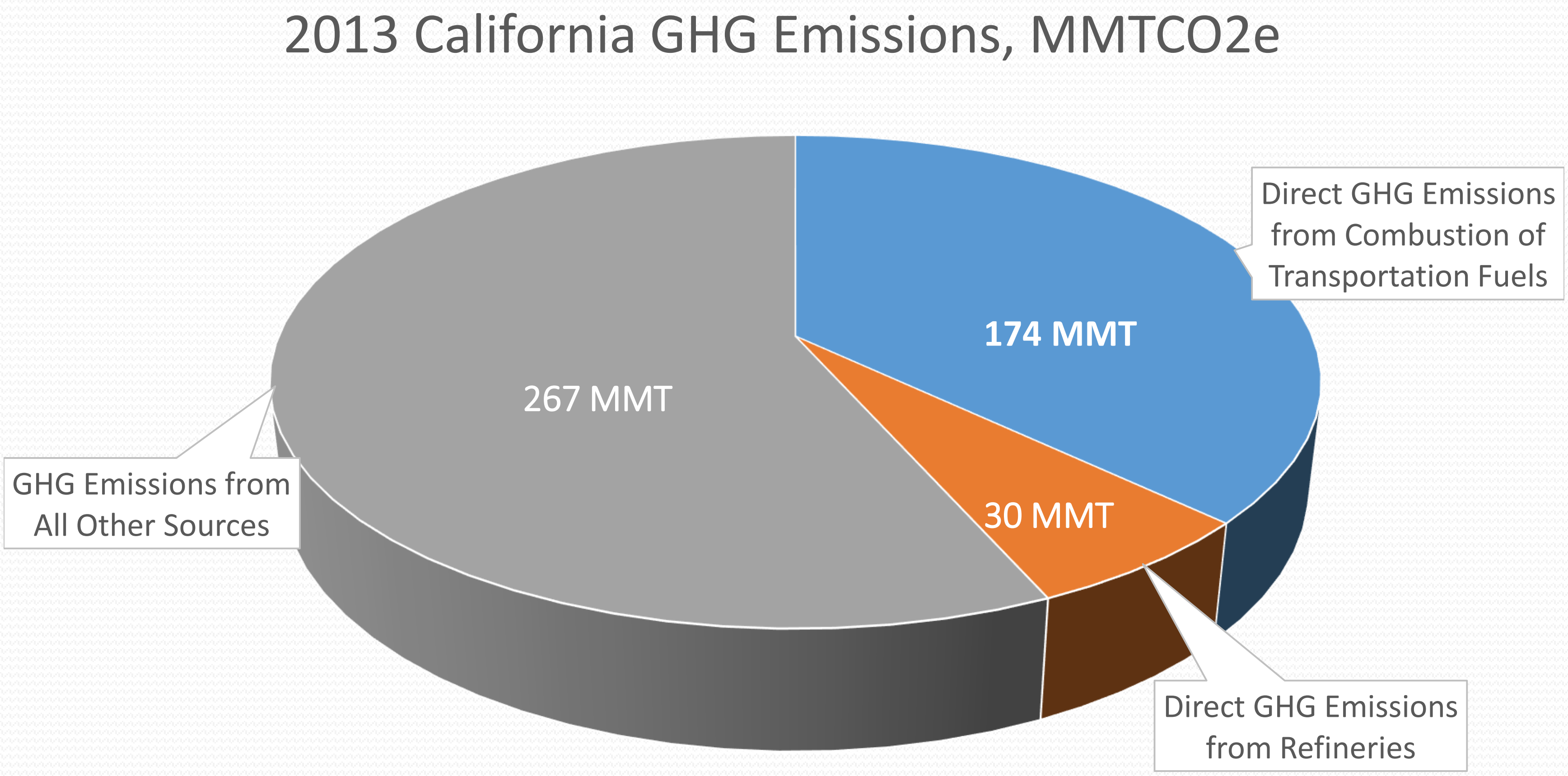
Inefficiency Example:
Combustion vs. Refining of Transportation Fuels

- Direct GHG emissions from the combustion of transportation fuels are much higher than the direct GHG emissions from petroleum refining statewide.

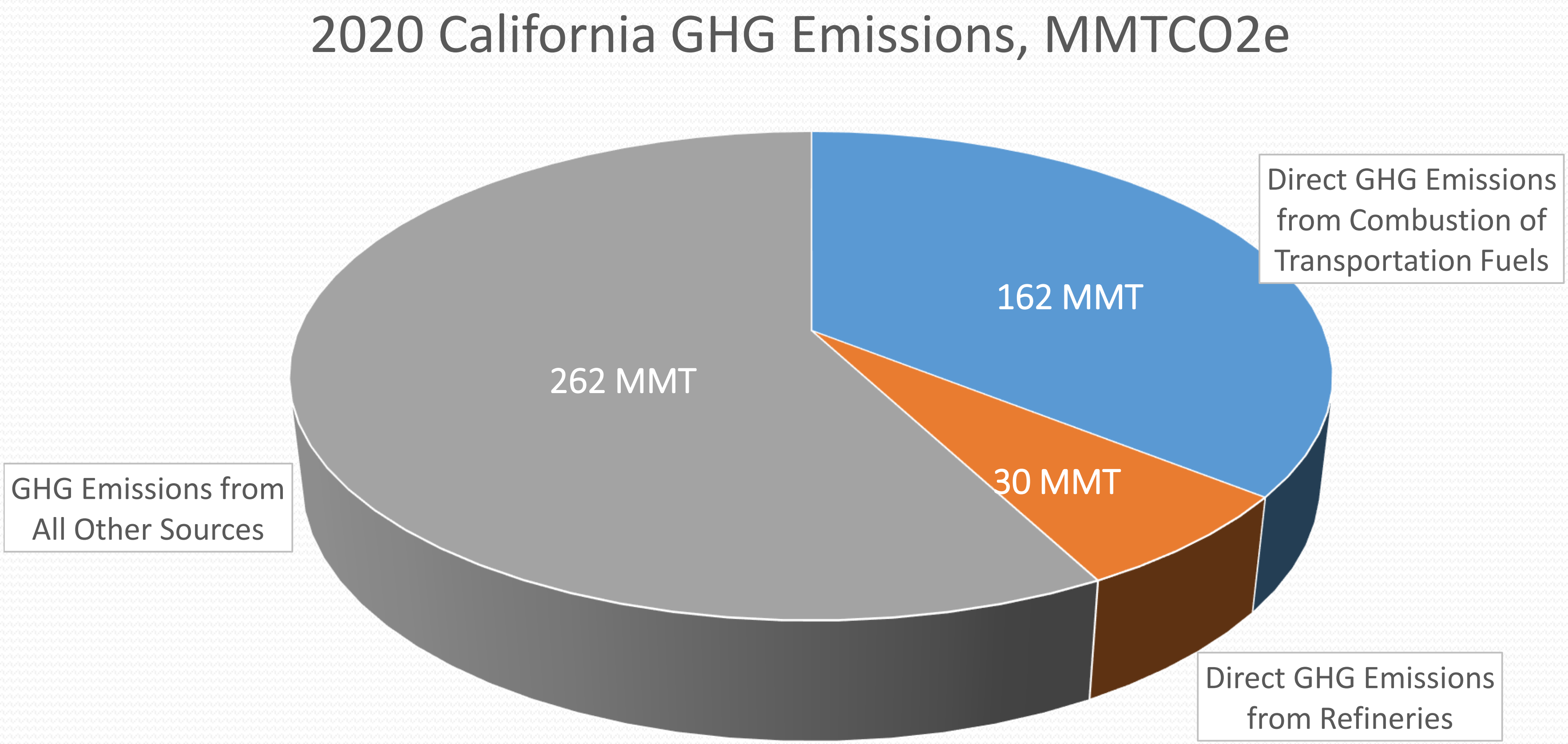
Combustion vs. Refining of Transportation Fuels (cont'd)

- The Low Carbon Fuel Standard (LCFS) addresses both direct AND indirect GHG emissions.
  - Includes GHGs associated with production and transportation of feedstocks and blending components
- To the extent that a limit on GHG emissions from refineries hinders the refiners' ability to reformulate transportation fuels to lower the GHG emissions from the combustion of those fuels, such a limit would be counterproductive.

Combustion vs. Refining of Transportation Fuels (cont'd)



Combustion vs. Refining of Transportation Fuels (cont'd)



Combustion vs. Refining of Transportation Fuels (cont'd)

- If refinery-specific caps on GHG emissions in the Bay Area made it difficult, or impossible, to complete refinery upgrades necessary to meet a new RFG or LCFS mandate, either:
  - Production at Bay Area refineries would be forced to decline, with production shifted to more distant refineries; or
  - The new RFG or LCFS mandates might be found to be infeasible.
- Either way, benefits from the combustion of lower carbon transportation fuels would be sacrificed in favor of the (likely much smaller) benefits of lower refinery GHG emissions.

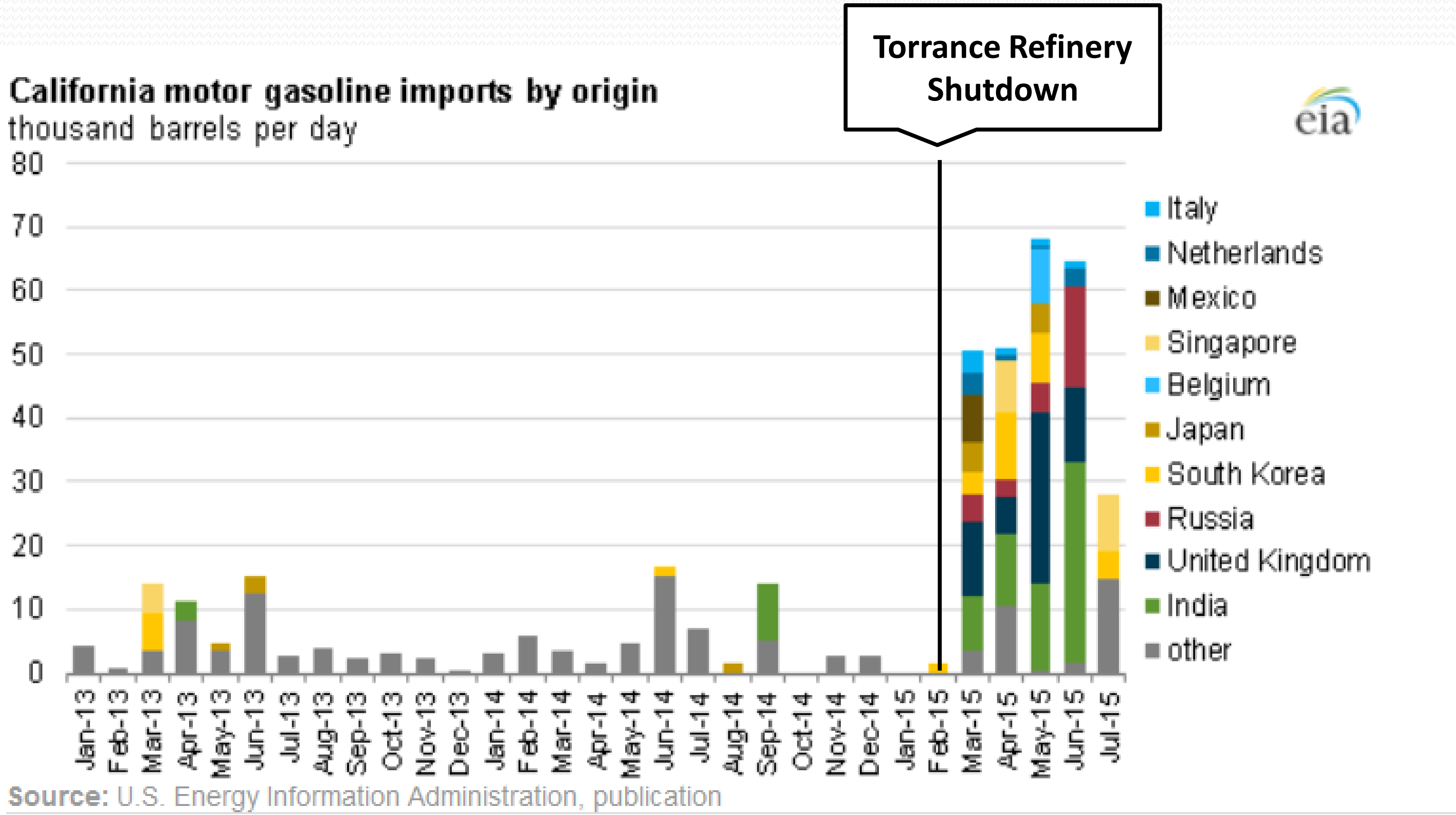
No Reduction in Statewide GHG Emissions

- GHG caps for Bay Area refineries:
  - Will not reduce overall statewide GHG emissions
  - Will not affect statewide GHG limits, which are set by the statewide cap
  - Will not affect the local demand for refined products, which will have to be produced elsewhere (leakage)
  - Will result in higher GHG emissions due to transportation of refined products from other refineries

No Reduction in Statewide GHG Emissions (cont'd)

- GHG caps for Bay Area refineries:
  - Will reduce the Bay Area refineries' need for GHG allowances from the cap and trade system, resulting in more credits available to other industries (power plants, etc.), allowing those industries to increase GHG emissions within the statewide cap, and changing the economics of in-state vs. out-of-state production (leakage)
  - Will limit the ability of Bay Area refiners to respond to a refinery outage in CA, leading to more imports and higher GHG emissions from transportation of refined products
    - Example: Over a 5-month period following the loss of supply due to the unplanned shutdown of the ExxonMobil Torrance facility in February 2015, gasoline imports to California increased more than 10-fold as compared with recent average levels.

Impact of a Refinery Outage on Gasoline Supply Sources



Source: EIA website, https://www.eia.gov/todayinenergy/detail.cfm?id=23312

No Reductions in Other/Local Pollutants

- If the basis for local GHG caps is their co-benefits with respect to other pollutants, then those alternative pollutants should be regulated directly, not through an indirect GHG cap.
  - Bay Area refiners have already been required to implement all feasible control measures and BACT during modifications; any further cost-effective measures to reduce criteria or TAC emissions must be adopted through a rulemaking process.
  - A GHG cap is unlikely to achieve further significant and immediate reductions in criteria pollutants or TACs unless it is deliberately designed to reduce the refining capacity of existing Bay Area refineries.

No Reductions in Other Local Pollutants (cont'd)

- If the issue is the source of crude, that issue is addressed through the LCFS, which accounts for the carbon content of crude oil used to produce California transportation fuels
- Refinery caps will interfere with the ability of refineries to make process changes needed to implement programs that reduce other pollutants.
  - For example, if EPA or CARB were to establish new fuel standards that would require refinery modifications, those modifications are likely to increase direct GHG emissions at the refineries in order to produce fuels with lower carbon content or other environmental benefits.

Conclusions

- There are no likely GHG benefits that would be achieved from imposition of a GHG sub-cap on Bay Area refineries.
- There are no likely co-benefits that would be achieved from such a sub-cap.
- Local GHG sub-caps will reduce the efficiency of the Cap-and-Trade program, thus increasing compliance costs for consumers throughout the state.
- There are a number of likely adverse impacts – increases in fuel prices, GHG emissions, and criteria pollutant emissions – that would result from GHG sub-caps on Bay Area refineries.

Sam Wade

California Air Resources Board

<u>Presentation and Discussion:</u>

Low Carbon Fuel Standard

Low Carbon Fuel Standard

Sam Wade, Branch Chief
Transportation Fuels Branch

April 25, 2016
BAAQMD Council Meeting
San Francisco, CA

California Environmental Protection Agency
Air Resources Board

Outline

- LCFS Basics and Progress through 2015
- Crude Oil and Refineries under the LCFS
- Questions and Discussion

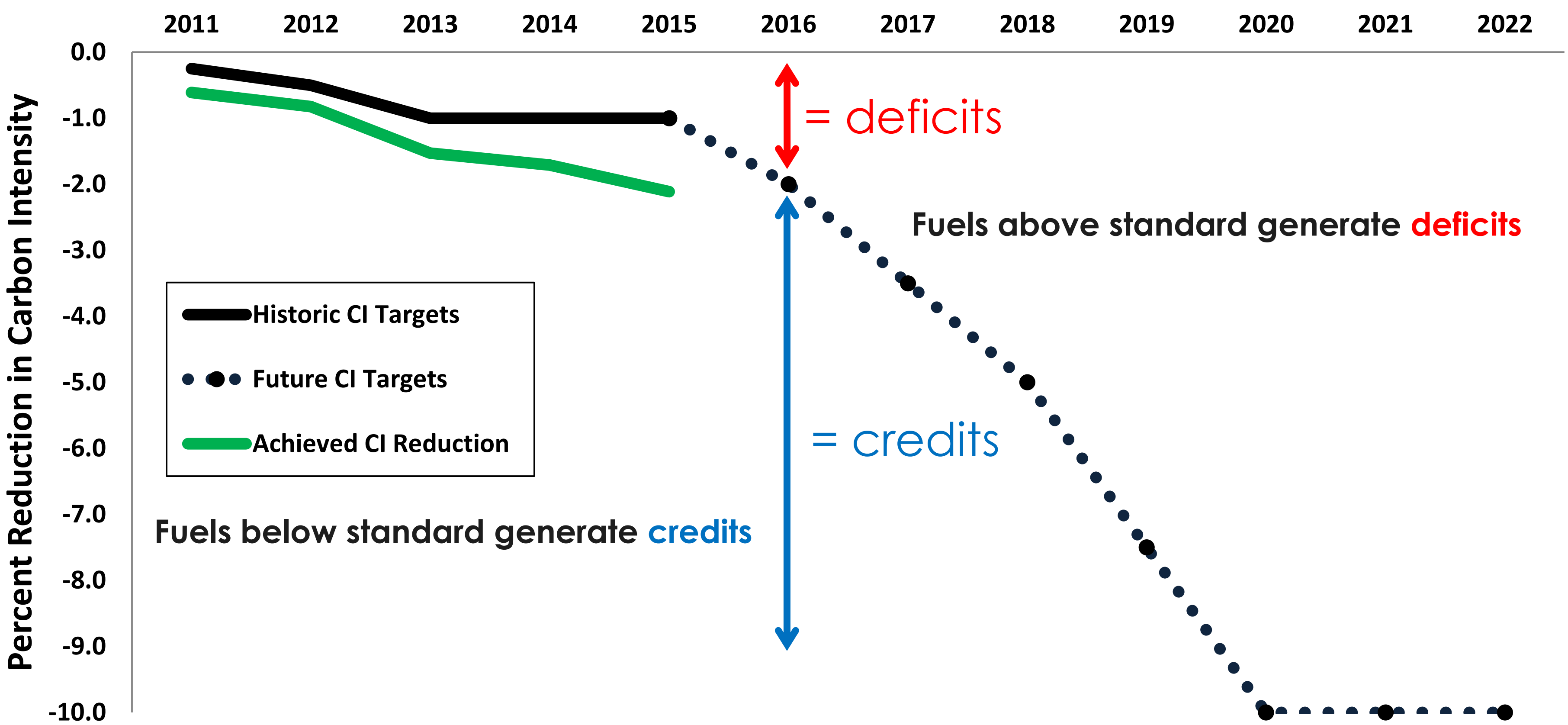
What is the Low Carbon Fuel Standard?

- Measure to reduce greenhouse gas emissions under AB32
- Established in 2009; Re-adopted 2015.
- **Fuel Neutral** - Promotes all low carbon fuels:
  - Electricity, Hydrogen, Renewable Diesel, Biodiesel, Renewable Natural Gas, Ethanol, etc.
- **Life Cycle Accounting** - Ranks fuels with Carbon Intensity (CI) scores according to the greenhouse gas emissions resulting from each fuel's production and consumption
- **Flexible** - Regulated parties can comply by:
  - Innovating to reduce the CI of their fuels,
  - Buying lower-CI fuels from other producers, or
  - Trading credits

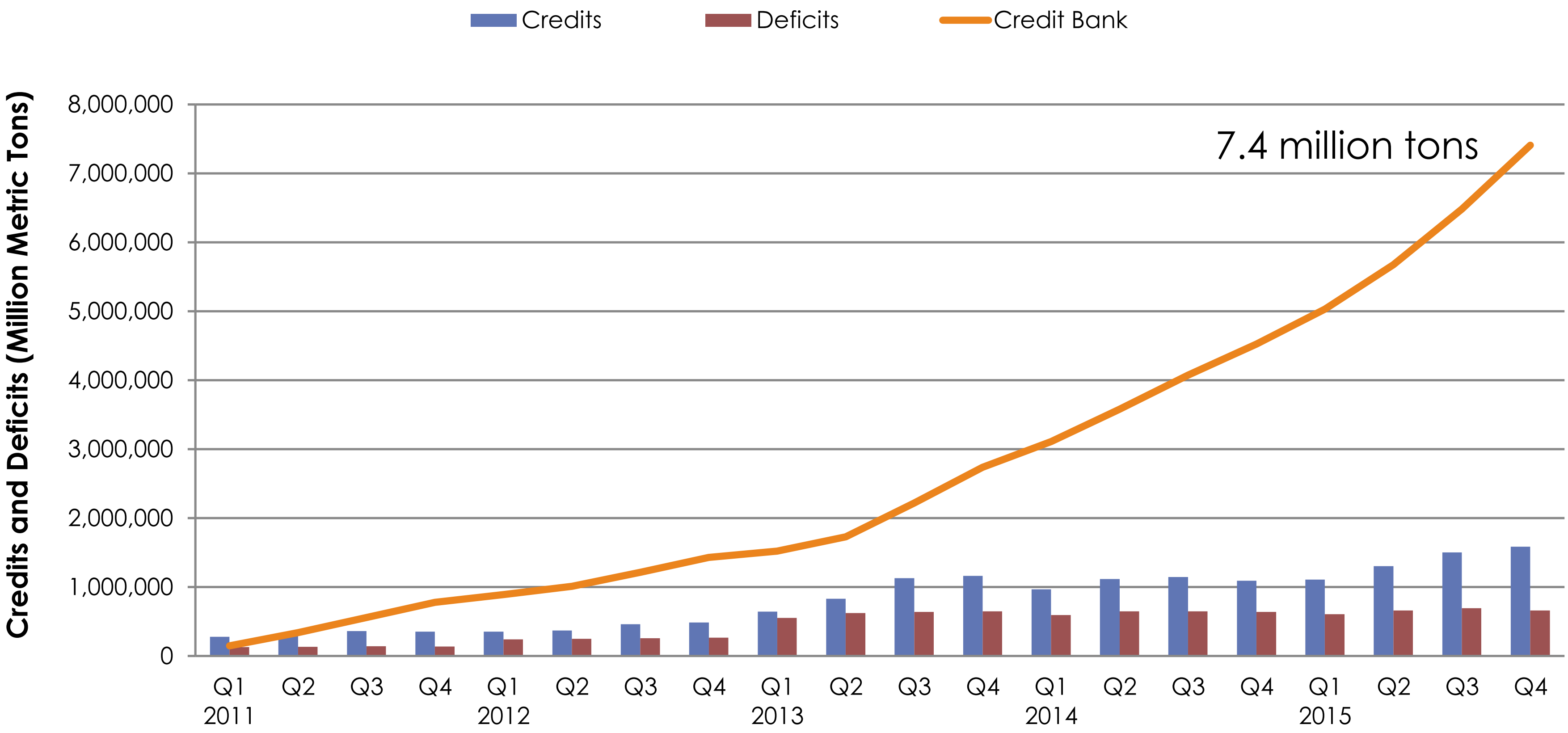
LCFS Objectives

- Reduce carbon intensity (CI) of transportation fuel pool by at least 10% from 2010 baseline by 2020
- Transform and diversify fuel pool by creating competition in the fuels market
- Reduce petroleum dependency

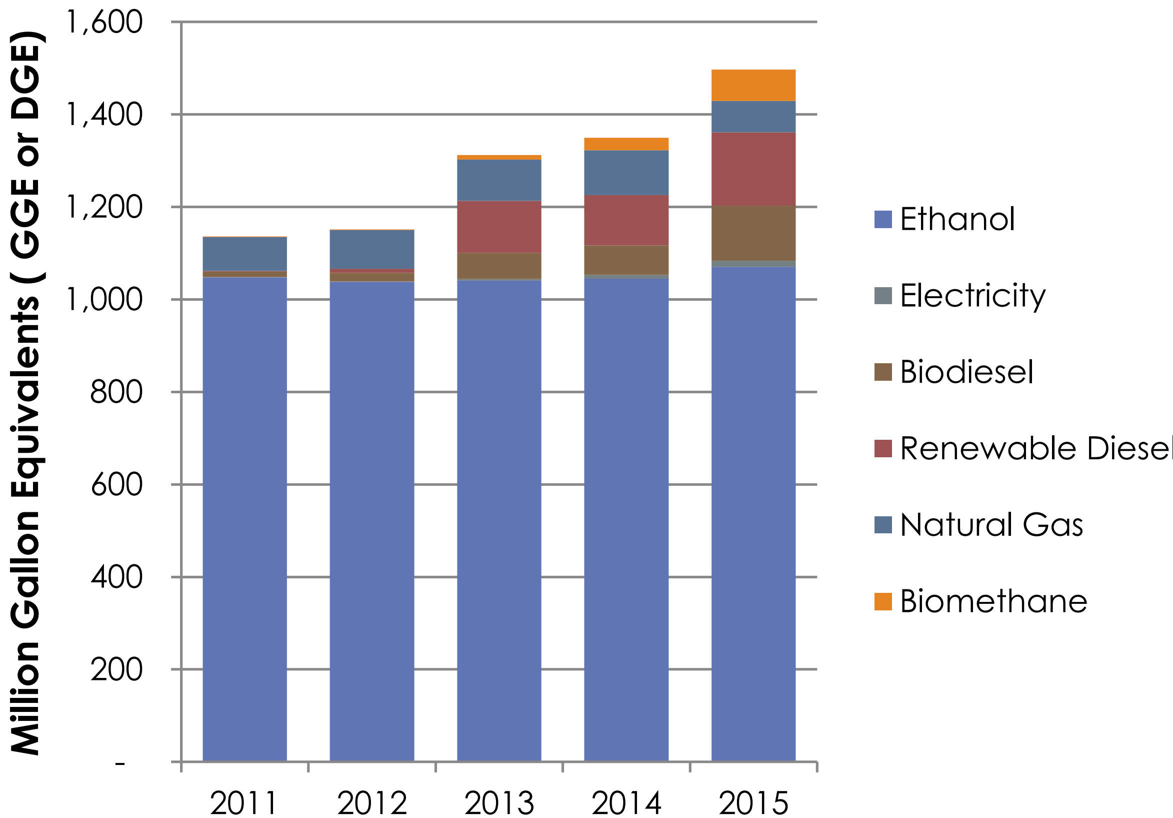
How Does LCFS Work?



Over-Compliance has Created a Large Credit Bank



Volumes of Low Carbon Fuels Continue to Grow



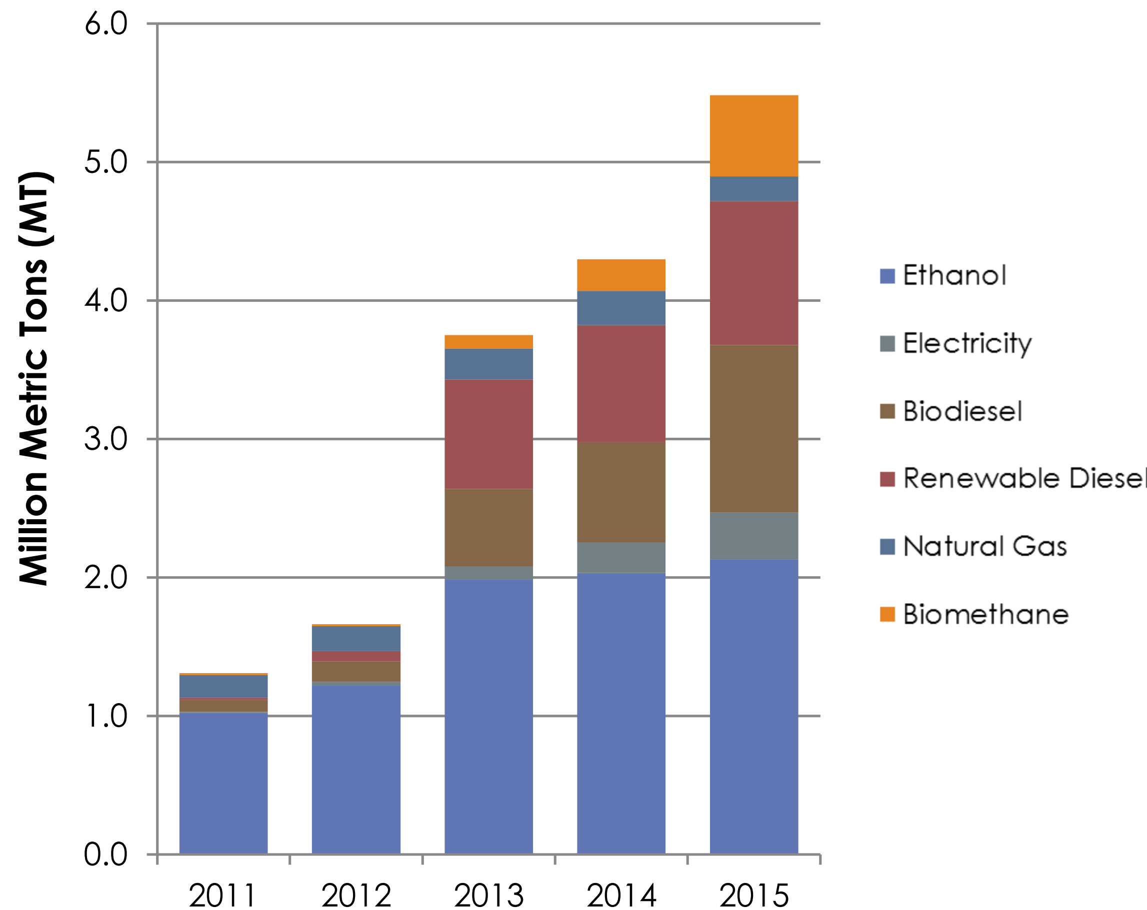
Before the LCFS, natural gas and ethanol were the only alternative fuels with any market share.

In 2015, we now have over 277 million gallons of Bio- and Renewable Diesel, and 67 million gallons of Renewable Natural Gas.

Advanced Fuels Contributing a Growing Share of LCFS Credits

Carbon intensity of each fuel is decreasing to remain competitive as more low-carbon alternatives emerge (more credits per MJ of fuel)

Fuels used in advanced vehicles (Electricity and Hydrogen) also produce more credits per MJ due to vehicle efficiency benefits



LCFS Credit Producers in San Francisco Bay Area in 2015

Outline

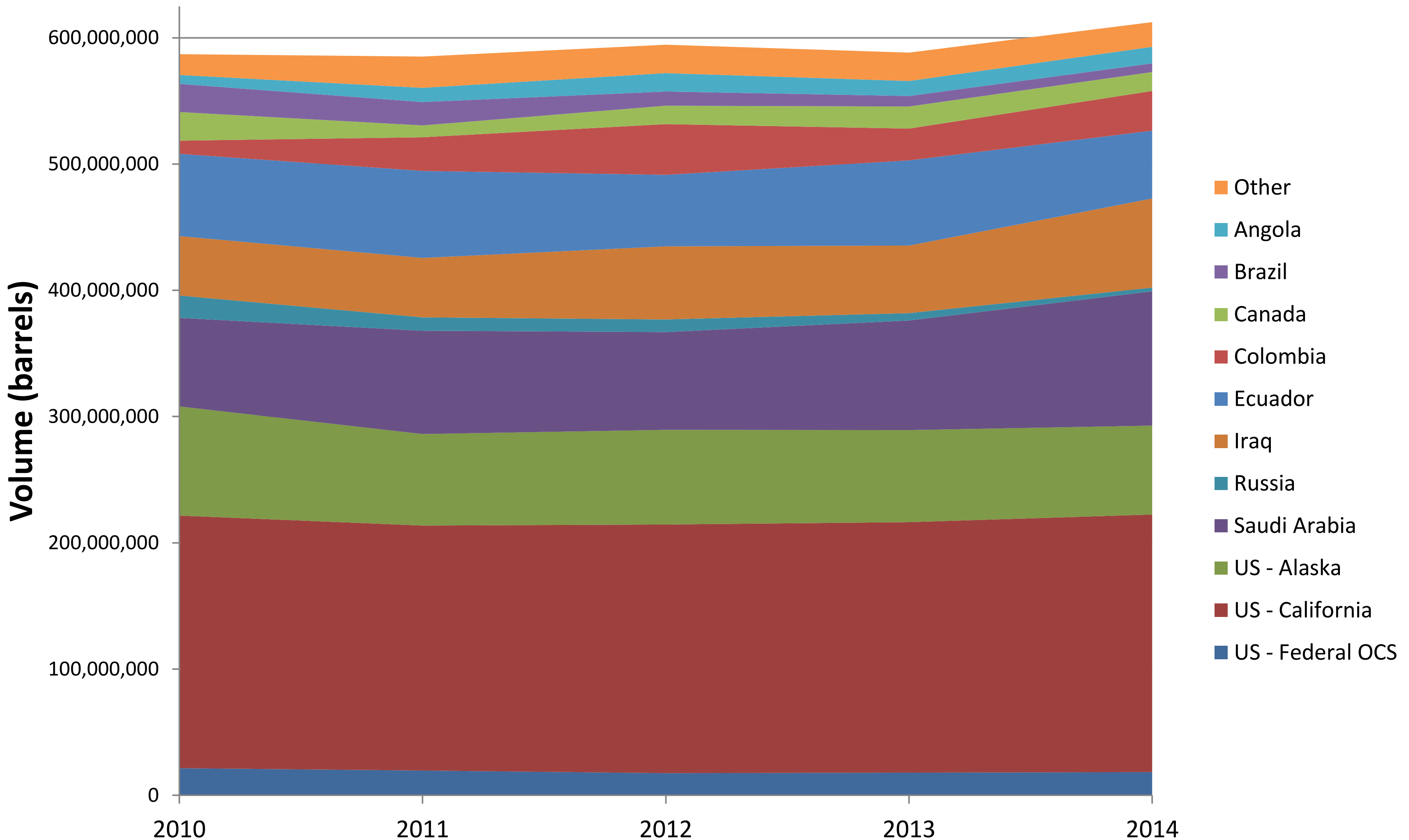
- LCFS Basics and Progress through 2015
- **Crude Oil and Refineries under the LCFS**
- Questions and Discussion

California Average Crude Oil Incremental Deficit Provision

- Discourages use of higher intensity crude
- Compares the "Three Year Rolling Average" Crude CI to the Average Crude CI in 2010 (LCFS baseline year)
- If the Three Year Average > 2010 Baseline CI, refineries are assessed an "incremental deficit" on CARBOB and ULSD

Year	CA Crude CI (g/MJ)
2010	11.39
2012	11.36
2013	11.36
2014	11.30

California Crude Slate: 2010-2014



Credits for Producing Crude using Innovative Methods

- Innovative method means crude production using at least one of the following technologies:
  - Solar steam generation
  - Carbon capture and storage
  - Solar or wind electricity generation
  - Solar heat generation
- Must achieve a carbon intensity reduction of at least 0.10 gCO_2e/MJ or emission reduction of at least 5,000 metric tons CO_2e per year

Refinery Investment Credit

- New provision that was added in during the re-adoption
- A refinery may receive credit for approved projects that reduce GHG emissions within the facility
- Reductions must occur within refinery boundaries
- Projects must achieve a reduction of at least 0.1 gCO_2e/MJ

Renewable Hydrogen Refinery Credit

- New provision that was added during the re-adoption
- A refinery may receive credit for approved projects that reduce greenhouse gas emissions from CARBOB or diesel fuel partially derived from renewable hydrogen
- Renewable hydrogen must annually replace at least 1% of all fossil hydrogen in CARBOB or diesel fuel production

Questions?

Break

Council Deliberation

- Key Question: What is the efficacy of numeric caps on GHGs from Bay Area refineries?

- Resources for Next Meeting

Public Comment on Non-Agenda Items